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ELECTRICAL ENGINEERING STANDARDIZATION.

Our esteemed contemporary the London *Electrician*, in a recent editorial article on this subject, makes some interesting comments on the last edition of the A. I. E. E. standardization rules. Such comments have the particular value that pertains to long-distance perspective, since a colleague situated at a distance can often see either a situation or a discrepancy more clearly than one close at hand. It is earnestly to be hoped that, in all fundamental physical characteristics, the electrical engineering standardization rules of different countries may be brought into union by the work of the International Electrotechical Commission. It is manifestly incongruous and harmful to general engineering interests that the fundamental rules which specify the nature and behavior of electrical machinery should differ from country to country. On the other hand, there are certain conditions local to each country that are unfortunately not amenable to adjustment or alteration, such as standard frequencies of alternation. The standard frequencies in this country are 25 cycles and 60 cycles per second. It is regrettable that these are not in simple two-to-one relation, such as 25 and 50, or 30 and 60; but it would be apparently hopeless at the present time to change them, on account of the large amount of capital already invested in machinery and apparatus producing these frequencies. Even supposing, however, that this country is indefinitely committed to standard frequencies not in agreement with those of other lands, this consideration ought not to introduce any serious impediment to the development of uniform international standardization rules. One of the suggestions thrown out in the article referred to is in relation to photometric and electrical engineering notation. The three symbols *I*, *E* and *R* have, by a most fortunate series of events, been adopted internationally for Ohm's law by the action of the International Electrotechnical Commission. Unfortunately these three symbols are also recommended in the A. I. E. E. standardization rules for certain photometric quantities. The photometric notation is as yet in a very primitive stage, from the international point of view, and it is greatly to be desired that international action shall be taken with regard to it. We are happy to say that the Illuminating Engineering Society has recently taken measures with a view to an international conference at The Hague next year on the subject of standards, nomenclature and notation relating to photometry and illuminating engineering.

ELECTRICAL REDUCTION OF IRON.

In another column will be found an instructive report concerning a Swedish plant for the direct reduction of iron from its ores in the electrical furnace, which is strik-

ing evidence of the possibilities of electrical power as a direct heating agent in large work. Electrical iron and steel making are by no means unfamiliar, but actual reports of tests, particularly in the direct reduction of iron ores, have been comparatively few. The plant here concerned at Trollhättan takes power from the Swedish government plant at 10,000 volts, three-phase, and employs in the furnace two-phase secondary currents derived from a pair of 1100-kva furnace transformers. Secondary voltages between 50 volts and 180 volts can be obtained and regulated during operation. The plant was established by the Swedish Association of Iron Masters and has been used in an experimental way on a considerable scale to find out the best working conditions, the stability of various electrodes and the general economic possibilities of the process. To this end electrodes of both German and Swedish makes were used, and twenty-nine different kinds of charge were run off, mostly from four varieties of ore. The general working of the apparatus appears to have been highly satisfactory, and the continuity of working has been very encouraging. In particular, the crucible in which the arcs are formed seems to have stood up to its work remarkably well. During nearly five months of continuous working only eighteen hours was taken out for crucible repairs. The electrodes, too, seem to have endured remarkably well. They are water-cooled as far as possible, and it is a fact worth noting that the heat lost in the cooling water amounted to nearly 7 per cent of the total load on the furnace, which would perhaps indicate that a careful balance should be struck between cost of electrode material and the power necessary to economize its use. The consumption of energy strikes one as considerable, amounting to nearly 2400 kw-hours per ton of iron reduced. At this rate approximately 3⅔ tons of iron would be produced per kw-year, which perhaps puts the matter in a more favorable light. Obviously, only very cheap power can profitably be utilized in the working of this interesting process, but given cheap power the possibility of producing a very high grade of iron by a direct electrical process with extremely small auxiliary fuel consumption is most important. It may be remarked that in Sweden and Norway twenty-four-hour electric power is sold as low as $5 per hp-year, and recently a figure as low as $3.50 has been reported.

A SEASONABLE REMINDER.

About this time, said the old almanacs, look out for snow. Similarly, this is the time of year when the underwriters and their electrical advisers issue a warning about the possible dangers from temporary electric wiring in window displays for the holiday season. These displays often include special electrical effects involving the use of both lamps and motors, together with Christmas trees and a liberal use of tinsel and cotton batting. Sometimes in the Christmas rush the special wiring is done hurriedly, and it is well to call attention to this possible danger now and to point out to all merchants and others in charge of Christmas displays that the special holiday wiring should be done by competent men. Sometimes the wires are carried over nails and there is some possibility that the insulation may be worn off, causing a spark, which, of course, the proximity of the highly inflammable material used in Christmas displays renders dangerous. Obviously, the use of electric lamps diminishes the fire hazard greatly, particularly in the case of Christmas trees, where miniature lamps are so often used in place of candles, with excellent results. Christmas trees lighted by candles, either in stores or in the home, are always dangerous, particularly after the trees get dried out in a warm room. But, even where electric lamps have replaced the dangerous candles, it is well to take all precautions. The holiday throngs in stores increase the danger of a possible panic from even a small fire, and it is to be remembered also that fire-insurance policies provide that if there is a material increase in the hazard, without permission, the insurance shall be void. Therefore, it is not amiss to utter a timely word of warning about possible dangers from careless wiring, or wiring done by incompetent persons, during the holiday rush.

SERIES INSTRUMENT TRANSFORMERS.

Although the fundamental equations for representing the performance of the several different types of stationary transformers are identical, yet certain factors that are relatively negligible in one type become of much importance in other types. Thus, in the shunt instrument transformer it is essential for the voltage ratio to remain closely constant, while the current ratio can be allowed to vary throughout a very wide range; in the series instrument transformer, on the other hand, the voltage ratio is of no immediate importance, but the current ratio must be maintained with the minimum of variation. For this reason the series and shunt instrument transformers differ radically in details of mechanical construction and are often treated as being essentially different in operating characteristics. Probably the most convenient method for representing the performance of either a shunt or a series instrument transformer is that involving the use of the equivalent one-to-one-ratio electric circuits for the actual primary and secondary electric circuits and the magnetic circuit of the apparatus. According to this plan, the primary circuit is connected directly in series with the secondary and load circuits, while in shunt with the latter two circuits is joined the magnetizing circuit, which is assumed to replace the magnetic circuit of the transformer. Obviously, to the extent that the magnetizing circuit current is negligible in comparison with the load current the ratio of primary to secondary currents will be equal to the inverse of the ratio of turns. To the extent that the primary and secondary circuits possess negligible impedance will the delivered emf bear to the impressed emf the direct ratio of turns. Operating requirements dictate small primary and secondary circuit impedances for shunt instrument transformers and large magnetizing circuit impedance for series instrument transformers.

To a predominating extent the characteristics of a series instrument transformer depend upon the magnetizing circuit. In view of the fact that the equivalent impedance of this circuit cannot be made infinite—that is, the admittance cannot be negligible—the transformer cannot possibly oper-

ate with a current ratio corresponding accurately to the inverse of the ratio of turns. However, the current ratio would remain constant under all operating conditions, even though the magnetizing circuit admittance were not negligible, if only this admittance remained constant. Constant magnetizing circuit admittance would mean constant permeability of the magnetic circuit and a core loss varying directly with the square of the magnetic density, neither of which conditions exists in nature. A complete analysis of the characteristics of a series transformer must therefore include a study of the variation in the permeability and core loss of the magnetic circuit throughout the operating range. Such a study is recorded in an article by Mr. Arthur P. Young which appears in this issue.

Of the uses to which a series instrument transformer is put the most usual is that of current transformer for ammeters. It is frequently used also to supply current to the series coils of a wattmeter or watt-hour meter. When used for this purpose the transformer must maintain not only a closely constant ratio of primary to secondary current, but the secondary current must be closely in time-phase opposition to the primary current. In determining the time-phase relations of the currents consideration must be given to the impedance of the secondary and load circuits, as well as to that of the magnetizing circuits. This fact is fully considered in the article by Mr. Young. Since it is physically impossible to construct a transformer with negligible magnetizing circuit admittance, and the secondary and load circuit impedance must have an appreciable value, it would seem that the series instrument transformer giving the most nearly perfect performance would be the one having an extremely high magnetizing circuit impedance of closely constant value and a secondary-load circuit impedance of low value, the reactive and resistance components of which bear to each other the exact ratio of the reactive and resistance components of the magnetizing circuit impedance. The time-phase displacement of the currents in such a transformer would always be zero, and the ratio of the current values would be constant, although not equal to the inverse ratio of turns—a defect of no importance whatsoever when the instruments are calibrated with the transformer with which they are to be used.

EXPERIMENTAL MEASUREMENTS OF STATIONARY ELECTRICAL WAVES ON PARALLEL WIRES.

It is well known that if we take a pair of parallel insulated overhead lines, such as might be used for a single-phase transmission circuit, and with their distant ends free we suddenly impress on the home ends any momentary electrical disturbance the disturbance transmits itself along the line at the speed of light. As soon as the disturbance, which might be a sudden charge, arrives at the distant free end of the line it is reflected back again toward the home end and continues to oscillate to and fro between the two ends of the line in much the same manner that a sudden mechanical disturbance communicated to one end of a long, horizontally stretched rope may be observed to run back and forth over the same. If the wires were devoid of resistance so that no energy was expended in heating them by the passage of current waves, such a system of electric oscillations might be expected to continue indefinitely. In any practical case, however, the electric oscillations so speedily subside that special means are required to reveal their existence. If the disturbance impressed on the home end of the line, instead of being a sudden electric shock, is a rapidly succeeding series of rhythmic, high-frequency impulses, then instead of a single wave of disturbance running to and fro over the line we obtain a train of waves so running. If the waves are still being shipped off at the home end when the head of the train returns from its first reflection at the far end, there will be a mingling or superposition of waves. In other words, the outgoing and returning waves will interfere. In general the interference will be irregular, so that the different sets of waves will cancel each other to a greater or less extent; but in the particular cases in which the returning waves happen to fall into step with the outgoing waves the blending leads to marked increase in the magnitude of the waves or there is a resonant building up of wave intensities. Moreover, the wave blending will be of such a nature that the resultant waves will not move. That is, the individual waves continue to run to and fro along the wires, but their mutual blendings in superposition result in stationary oscillations, which are, therefore, relatively easy to detect.

There are two ways in which such wave systems can be investigated experimentally. One is to employ actual transmission lines many miles in length, to impress moderate-frequency electric oscillations upon them at one end, and to measure with ammeters, voltmeters or oscillographs the resulting system of wave disturbance as the frequency is varied. This is essentially an engineering method. The second way is to employ in a laboratory a pair of thin parallel wires a few meters in length and to impress on one end of the line a very high-frequency disturbance in such a manner that with the aid of delicate galvanometers the resulting system of stationary waves can be measured as the length of line is varied. This is essentially a method of physical science. A research with the second method by Messrs. F. C. Blake and Charles Sheard has recently been published in the *Physical Review* under the title, "On the Free Vibrations of a Lecher System Using a Lecher Oscillator." The results show that if the ends of the line are open at the distant end stationary waves can be set up when the line length is one, two, three, four, five, etc., times the wave length of the impressed oscillation, corresponding to what may be considered by analogy to occur acoustically in an organ pipe with the distant end open. If, on the contrary, the distant ends of the wires are connected or their circuit closed, then stationary waves can be set up when the line length is one, three, five, seven, etc., times the wave length of the impressed oscillation, corresponding to the acoustic analogy of what occurs in an organ pipe with the distant end closed. There is thus a remarkable analogy between electric resonance over a pair of parallel wires and acoustic resonance in an organ pipe. Of course, the nature of the oscillation in the two cases is very different, the one being ethereal and electromagnetic, the other being gaseous and involving the motion of material particles.

Annual Meeting of A. S. M. E.

The 1911 annual meeting of the American Society of Mechanical Engineers was held in the Engineering Societies Building, New York, Dec. 5 to 8 inclusive, the convention opening with a social session and reception Tuesday evening, when Dr. A. C. Humphreys was installed as president. His predecessor in office, Col. E. D. Meier, delivered his retiring address on "The Engineer in the Future," in which he declared engineering to be the profession of both the present and the time to come. The engineer, he added, is a devout believer in natural laws, needing no superior court to define them as "reasonable," for every infraction of such laws brings its punishment.

At the Wednesday afternoon session a report on "Tests of Large Boilers at the Detroit Edison Company," by Prof. D. S. Jacobus, was read by Mr. H. O. Pond, who was in immediate charge of the tests. These huge Stirling boilers, rated at 2365 hp on a basis of 10 sq. ft. of heating surface per hp, commonly supply steam outputs of 8000 kw, and have each furnished 11,000 kw for short periods. But even more notable than the great size of these double-fired units, which measure 26 ft. wide, 14 ft. deep and 29 ft. high, are the economies of performance which they show, having an over-all efficiency of 80 per cent at nominal rated loads, and decreasing to 76 per cent at 100 per cent overload. One of the boilers tested was equipped with Roney stokers, taking 1½ per cent of the steam generated for its jets and stoker engine. The Taylor underfeed stoker for the other boiler required about 3 per cent of the steam generated to drive the turbines of its draft blowers, returning its exhaust to the feed-water heaters. Professor Jacobus gave credit to Mr. Alex. Dow, general manager of the Detroit Edison Company, for the idea and installation of the huge boilers at Delray, the equipment being developed by the engineers of the Babcock & Wilcox Company and of Westinghouse, Church, Kerr & Company. In conclusion the writer remarked that he is engaged in developing a boiler to combine the performance of the Detroit units with those of the marine type, insuring sustained high efficiencies at outputs from 80 to 400 per cent of nominal rating.

In the discussion Mr. R. H. Rice pointed out the advantages of reduced labor cost, space and real estate with such large boilers, and the resulting improved simplicity of fire-room layout, although he added that the maintenance of brickwork remains a question. He also suggested arrangements for adding cold feed-water to shut off the steaming output of large units in emergencies. Mr. R. D. DeWolf presented a number of curves comparing superheater pressure drop, flue-gas temperatures, CO_2 content, etc., in the cases of the two different stokers tested. Mr. W. D. Ennis computed the economy of the Detroit units to be 1.9 lb. coal per kw-hour, tracing the high efficiency to reduced furnace radiation losses. Mr. B. C. Johnson said that these large boilers achieve 89 per cent of the theoretically possible 87 per cent thermal efficiency. Mr. H. H. Esselstyn, the consulting engineers' resident representative at the Detroit station, exhibited photographs and sketches of successful and abandoned furnace brickwork constructions. Prof. William Kent declared the present tests to show the highest efficiencies ever obtained with coal containing more than 25 per cent of volatile matter. Mr. R. G. Carpenter ascribed the high Detroit economies to close control of air supply, the excess oxygen being limited to the condition of maximum efficiency. Mr. E. D. Dreyfus compared gas-engine economies with the steam efficiencies of the Detroit units, obtaining about 23,000 heat units per kw-hour in each instance, although the turbine plant benefits from its greater reliability of operation. Mr. H. G. Stott warned against huge boilers as a panacea for boiler troubles. The large volatile content of the coal used, he said, specially suited the high combustion chambers of the Detroit boilers, but he asked why the tests were not carried beyond 214 per cent of normal rating, which is a very conservative loading in the light of present practice. Mr. Stott also pointed out that the fixed charges of investment are especially important at light loads, so that it may pay to lose efficiency at overloads if the fixed charges, which must be continuously carried, can thereby be reduced.

A paper on "Herringbone Gears" of the Wuest system was next presented by Mr. P. C. Day, Milwaukee, Wis., among the applications of such gears suggested being the turbine operation of low-speed, direct-current generators, marine propellers, steel-mill rolls, motor-operated pumps, etc., in addition to the use of magnifying ratios for driving electrical generators from low-speed waterwheels, etc.

Mr. James E. Howard next abstracted his paper on "Strain Measurements of Some Steam Boilers Under Hydrostatic Pressures."

A special parallel session was held Wednesday afternoon by members interested in cement-plant engineering. Mr. Frederick H. Lewis presented a paper on "Electrical Power in Cement Plants," in which he compared auxiliary and motor drive, concluding that the electric mill is advantageous in sizes above 2000 bbl.

Mr. J. D. Porter confirmed the advantages of electricity to cement manufacturers, enumerating arguments obtained from users of motor-driven plants, among which he mentioned economy, flexibility, fitness, accuracy of cost measurement, etc. With the exception of three, he said, the last twenty plants built have installed electric drive.

Letter Cablegrams.

To popularize transatlantic cable service for business and social messages the Western Union Telegraph Company makes the interesting announcement of the establishment of two new forms of cable service between the United States and England on Dec. 6. These two forms are known as cable letters and week-end letters. The former may be filed at any Western Union telegraph office to be forwarded to the cable offices at New York or Boston. Thence they will be cabled at the convenience of the company to reach London or Liverpool in time for delivery on the morning of the second day following receipt in New York or Boston. The tariff for cable letter is $1.50 for twenty words, with 30 cents for each additional five words.

Week-end letters may be filed up to midnight on Saturday for delivery in London or Liverpool on the following Tuesday morning. The rate is $1.50 for thirty words, with 25 cents for each additional five words. In each case these rates are for cable transmission only, although if desired messages will be mailed from cable offices to destination without extra cost. If telegraphed to or from cable offices, the regular land-service tolls will be added. Cable letters and week-end letters must be written in plain English words. In cable transmission address and signature words will be counted and charged for. Previous transatlantic cable rates have been 25 cents a word.

In addition a deferred-service cable rate of one-half existing full-price rates will be established on Jan. 1. These messages are liable to be deferred for a period not exceeding twenty-four hours.

Commencing on Dec. 15 deferred press dispatches in plain English for American papers will be accepted at the cable rate of 5 cents a word.

It is of interest to add that the first of the new cable letters was dispatched on Dec. 7 from the Postmaster-General of the United States to the Postmaster-General of Great Britain.

The Commercial Cable Company will meet the cut in rates in relation to deferred-service cablegrams and deferred press messages.

New York Jovian Luncheon Club.

New York City, although the most important electrical center of the country, has lagged behind other large cities in providing means for bringing electrical men together socially. This reproach has at last been removed, and last week the lead of Philadelphia, Chicago, Denver, Pittsburgh and other cities was followed in the establishment of a luncheon club in the metropolitan city by the Order of the Rejuvenated Sons of Jove. As is well known, this is a national organization of electrical men, which, though largely social, and at "rejuvenations" jovial, in character, has also a serious object, namely, to bring together electrical men for co-operation in advancing the commercial side of the electrical industry. The slogan of the organization is "All together, all the time, for everything electrical," and the vigorous work it is performing in binding together electrical men for co-operation in advancing the cause of electricity is admirable in every respect. The membership of the order now exceeds 5000, and there are branches in every section of the United States and Canada where there is any considerable electrical activity. Owing to the more serious purpose of the organization, all who are interested in advancing the electrical industry are eligible as members. The institution of luncheon clubs has been found to advance very highly the co-operative feature of the order, through bringing men together under favorable conditions for the exchange of information for their mutual benefit and for the advancement of electrical interests in general.

The movement toward the formation in New York City of a Jovian Luncheon Club was brought to a favorable conclusion under the leadership of Mr. G. E. Watts, statesman for New York, and Mr. George W. Elliott, statesman at large, with the assistance of Mr. J. B. Olsen, Mr. B. M. Downs and other local members of the order. At the first luncheon, held Nov. 29, there was a most gratifying attendance, the total being 104; and the interest and enthusiasm manifested on that occasion clearly indicated not only the need of such a social center as the club will afford, but the warm spirit with which it will be supported.

Mr. Watts presided, and at the close of the luncheon in well-chosen words informed those present of the plans that had been matured, and asked the hearty co-operation of all members of the order in making the semi-monthly meetings at luncheon a means for the reunion of all men in New York City and vicinity having the interest of the electrical industry at heart. He pointed out how the opportunity thus afforded would, aside from its social features, conduce to the advancement of the cause of electricity by promoting the spirit of co-operation which today is characteristic of all successful industrial advancement. He stated that at each luncheon a short talk would be given by a man of prominence in public life or in the national or local commercial or industrial field. As the luncheons will end promptly at 2 p. m. their attendance will not result in any material inconvenience to busy members.

Mr. Washington Devereux, statesman for Pennsylvania, was the guest of honor and gave an interesting talk on "Jovian Luncheon Clubs," during which he described the methods which had made the Philadelphia club the leading one of the order, and dwelt upon the great benefit it had conferred on the electrical fraternity of the Quaker City. Formerly there was very little acquaintance between electrical men of that city, and those engaged in the same line of work were inclined to take opposite sides of the street in order to avoid each other. That condition, Mr. Devereux said, had absolutely changed since the formation of the club. Meetings at luncheons established human relations which mitigated the effects of competition between those engaged in the same line of work and induced a hearty spirit of co-operation in the general advancement of the electrical trade. The address of Mr. Devereux was in true Jovian vein and was enthusiastically received.

Work of the Commercial Section of the N. E. L. A.

A permanent office for the Commercial Section of the National Electric Light Association has been opened in the Engineering Societies Building, New York City, by Mr. Philip S. Dodd, secretary of the section. The general offices of the association are also in this building. A meeting of the executive committee of the section will be held in the new office Dec. 9, and the tentative program of the year's work outlined at the previous meeting in Chicago will be discussed and details will be settled definitely.

The Commercial Section is doing a work of increasing practical importance. Its membership is well on to 1000. At the New York N. E. L. A. convention last June the reports of the various committees embraced a collection of valuable data. The two booklets of the section—one on "Data on Electric Signs," prepared by the sign committee, and the other on "The Electrical Equipment of the Home," prepared by the wiring committee—already have demonstrated usefulness by the fact that they have attained a combined circulation of over 65,000 copies.

Final committee appointments have been made. At least three of the committees will prepare publications, to be available to members for general distribution probably before the date of the coming Seattle convention. These reports are intended to demonstrate the possibilities of electric service and to stimulate interest in the varied uses of electrical energy. Definitely classified information will be given on such subjects as street lighting, industrial lighting, residence lighting and domestic heating and cooking appliances.

Perhaps the most vital feature of the work planned for the coming year will be the compilation of a "cumulative commercial index," in which it is hoped to give in a readily accessible form all classes of information useful to the commercial men of the electrical industry. This index will consist of a digest of commercial articles that have appeared in the technical press for a period of perhaps five years past. It will also include papers read before societies on subjects having a commercial bearing. Further, there will be chapters devoted to electrically operated devices, with descriptions of such devices, as well as price lists and other information of this character. Questions relating to public policy and the mutual relations of operating companies, contractors, jobbers and consumers will also form a feature of this work.

It is proposed to establish an advertising exchange for all members, which will concentrate in the central office in New York examples of all classes of advertising devoted to the sale of electricity and electrical devices. Other features of the work of the section are in prospect, and, taken in all its aspects, the comparatively new Commercial Section promises to become a vital factor in the commercial development of the electrical industry as a whole. Its work should have a direct bearing on the success of operating companies, manufacturers and jobbers.

Following is a list of the names of the chairmen and secretaries of the various section committees: Commercial development of the electrical industry, Mr. W. W. Freeman, Edison Electric Illuminating Company of Brooklyn, chairman; cost of commercial department work, Mr. E. L. Callahan, H. M. Byllesby & Company, Chicago, chairman, and Mr. J. G. Learned, Public Service Company of Northern Illinois, Chicago, secretary; competitive illuminants, Mr. F. H. Golding, Rockford Electric Company, Rockford, Ill., chairman, and Mr. Ward Harrison, Cleveland, secretary; steam heating, Mr. S. M. Bushnell, Illinois Maintenance Company, Chicago, Ill., chairman, and Mr. Thomas Donahue, Merchants' Electric Light Association, Lafayette, Ind., secretary; selling electricity to large power users, Mr. Joseph Lukes, Truckee River General Electric Company, Reno, Nev., chairman, and Mr. Stanley Walton, Pacific Gas & Electric Company, San Francisco, Cal., sec-

retary; residence business, Mr. J. F. Becker, United Electric Light & Power Company, New York City, chairman, and Mr. H. H. Boynton, Cleveland, secretary; industrial and commercial lighting, Mr. E. H. Beil, Youngstown Consolidated Gas & Electric Company, Youngstown, Ohio, chairman, and Mr. F. B. Rae, Jr., New York, secretary; commercial electric refrigeration and ventilation, Mr. J. W. Meyers, 1000 Chestnut Street, Philadelphia, chairman; electric advertising and decorative street lighting, Mr. W. H. Hodge, H. M. Byllesby & Company, Chicago, chairman, and Mr. Claude Bender, Cleveland, secretary; contract order routine, Mr. T. I. Jones, Edison Electric Illuminating Company of Brooklyn, chairman, and Mr. M. S. Seelman, Edison Electric Illuminating Company of Brooklyn, secretary; membership, Mr. George Williams, 60 Wall Street, New York City, chairman, and Mr. W. W. Dodd, Cleveland, secretary; electric vehicles, Mr. L. R. Wallis, 39 Royalston Street, Boston, chairman, and Mr. P. D. Wagoner, Long Island City, N. Y., secretary; commercial index, Mr. E. L. Callahan, H. M. Byllesby & Company, Chicago, chairman.

Electric Vehicle in Boston.

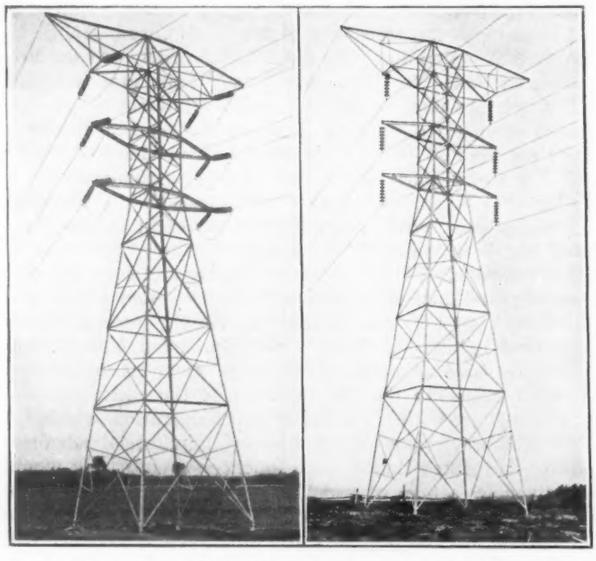
At a meeting of the Boston Electric Vehicle Club held on Dec. 6 the discussion was largely devoted to publicity methods, in view of the maturing of plans for newspaper campaigning in 1912. It was announced that about $3,600 had already been secured, on the desired basis of $100 per month per vehicle dealer represented at Boston, for pushing the advertising work of the coming year. The dealers are enthusiastic as to the results already attained and as to future possibilities. Besides its newspaper advertising, the club is working in various other ways to stimulate the trade and educate the public as to the vast strides of the industry in recent years. Its plans for a great display at the Boston 1912 Electric Show are arousing popular interest as never before. Special emphasis was laid upon the necessity of appropriations along the above lines to enable the seed sown to be harvested in the form of a great tide of popular interest and patronage in the coming months.

Mr. Frank J. Stone, Boston, suggested the operation of an educational lantern-slide exhibit in the streets with an electric vehicle as the stage, the use of telling headlight effects, and the installation of stencil projecting lamps on the vehicles which would throw the words "Electric Vehicle" upon the sidewalk whenever a truck or pleasure car approached the curb. In view of its trifling cost and effectiveness, the latter suggestion was received with much enthusiasm. A representative of the *Electrical World* called attention to the value of the automatic motor-driven stereopticon, as illustrated in the interurban station of the Pacific Electric Railway Company in Los Angeles, where the scenic attractions of the mountain and beach country reached by the lines are displayed consecutively for hours to persons in the waiting-room without any expense for attendance. Mr. C. F. Smith, of the Boston Edison company, mentioned the value of an electric emergency truck as a helper of teamsters on slippery pavements. Mr. E. S. Mansfield touched upon the great advertising value of such service. Mr. Tiffany, Boston, outlined the electric ambulance service now maintained by the Massachusetts Society for the Prevention of Cruelty to Animals. It was hinted that large applications of the electric vehicle in New England fire-department service are probable in the near future, members of the club who have seen the pioneer work at Springfield, Mass., speaking most enthusiastically of the results of operation in that city. Brief remarks were also made by Messrs. Thomas Glenn, La Rue Vredenburgh, C. R. Erkman and Welles E. Holmes.

It was announced in closing that at the meeting of the New England Section of the Electric Vehicle Association of America to be held at the Lynn works of the General Electric Company on Dec. 14 Mr. H. S. Baldwin, head of the department of small motor manufacturing, would read a paper contrasting vehicle motors of ten years ago with present products. The announcement was also made that Prof. Elihu Thomson would address the meeting on vehicle motive power, as originally planned. At the last meeting of the club it was voted that members would go from Boston to the meeting exclusively in electric machines.

New 100,000-Volt Line Placed in Operation Between Shawinigan Falls and Montreal.

The new line of the Shawinigan Water & Power Company between its new hydroelectric station at Shawinigan Falls and its new terminal station at Maisonneuve, on the outskirts of Montreal, has recently been placed in operation. The development has been carried on with remarkable dispatch under the supervision of the company's own staff, headed by Mr. Julian C. Smith, general superintendent and chief engineer. The head works for the new station were begun in May, 1910, and the power-house cofferdam in September of that year. The work was carried on incessantly and concrete was set with the thermometer registering 20 deg. below zero. The work on the transmission line began last May, and the line was operated at 50,000 volts in October. In November transmission at 100,000 volts began,



Strain Tower and Intermediate Tower on the Shawinigan Falls Line.

and on Nov. 14 one of the 12,500-kva, three-phase transformers in the terminal station was carrying full load.

The new power house at Shawinigan Falls is designed on the unit system, as is also the terminal station at Maisonneuve. The hydroelectric station will house three units, two of which are at present installed. The wheels, which were built by the I. P. Morris Company, Philadelphia, are of the twin spiral-case type, rated at 20,000 hp under a 145-ft. head. They operate at 225 r.p.m. and drive 14,000-kva, 6600-volt, three-phase, 60-cycle alternators built by the Canadian Westinghouse Company. The energy passes to a 14,000-kva, three-phase transformer built by the General Electric Company, which steps up the potential from 6600 volts to 100,000 volts.

The transmission line is about 85 miles, and for a distance

of about 60 miles parallels the tracks of the Canadian Pacific Railway on a 100-ft. private right-of-way. The line is approximately 10 miles distant from the company's other lines running to Montreal. The types of steel towers employed are shown in the accompanying engraving and were designed by the company's engineering staff. They are 70 ft. high and have a 20-ft. base. They carry six 250,000-circ. mil aluminum cables and two 3/8-in. steel cables as ground wires. The towers are spaced 520 ft. apart, and every eleventh tower is a strain tower. Strain towers are also provided at all angles. Electrolytic lightning arresters of the General Electric type are installed at both ends of the lines. At the Ottawa River there are two long spans of 1300 ft., with special towers on each bank.

The new substation at Maisonneuve is a short distance from the old terminal station in the same town. The dominating idea of the design has been to make each unit from the water to the terminal station at Montreal complete in itself. Thus there is a single wheel driving a single alternator connected to a single three-phase transformer feeding a single transmission line which supplies energy to a single step-down transformer at the other end. Provision is made for three units in the terminal station just as there will be three units in the generating station with a two-circuit transmission line. The terminal station can be extended if need be without disturbing the arrangement or interfering with operation by simply adding new sections to one end of the structure. The switching apparatus and control in the terminal station is of Canadian Westinghouse manufacture, and the transformers are of General Electric make. Since the station was placed in operation the company has been more than pleased with the results. The older transmission lines of the company operate at 50,000 volts.

Turin International Electrical Congress.

Electric Light, Heat and Traction.

In Section IV of the Turin International Electrical Congress papers on electric light and heat were presented, and in Section V papers on electric traction. Abstracts of these papers follow:

ELECTRIC HEATING.

Mr. C. A. Rossander presented a very comprehensive report on the present state of the art of electric heating and its future development. Beginning with a short résumé of the various methods of transforming electrical energy into heat, he promptly excludes those industrial operations where electric heating is used for producing very high temperatures and proceeds with a description of the various fundamental types of construction used in the manufacture of commercial heating apparatus where moderate temperatures and relatively small quantities of energy are dealt with.

Leaving the question of design, he treats of the applications of electric heat, commencing with electric cooking. Actual figures are given of the amount of energy in kilowatt-hours necessary to cook different kinds of food. The average figure for meat is given as 0.4 kw-hour or 0.5 kw-hour per kilogram.

Comparing an illuminating-gas stove with an electric stove on the basis of equal heating value, 1 kw-hour of electric energy is equivalent to 0.415 cu. m of gas. However, on account of the more perfect regulation possible with electricity, this figure was said to be somewhat low, and after giving similar figures from different sources the author concludes that 1 kw-hour of electric energy should be considered as equivalent to not less than 0.5 cu. m and not more than 1 cu. m of illuminating gas.

In discussing the inherently unfavorable characteristics of a cooking load and the methods of minimizing them so as to reduce the cost of energy supply for this purpose, mention is made of the long-hour heating apparatus used in Hartford, Conn., which was described in the *Electrical World*, Vol. 57, page 45.

Electricity offers many practical advantages over coal or wood in heating large ovens for baking on a commercial scale. Professor Eckstrom in Sweden has made experiments in this direction and has found that the best results are attained by heating the oven to a given temperature and then cutting off the current and letting the oven gradually cool off, the temperature being so chosen that the bread will just be done when the oven has cooled off. The heating of water does not offer a very attractive field from the economical point of view except where cheap energy is available.

In speaking of various other domestic uses of electric heat, the author mentions a laundry near Paris where the proprietor was willing to pay three times as much for electric heat as for coal heat.

Dr. Epström has made some interesting tests on electric house heating near Stockholm, where the average yearly temperature is + 6 deg. C. By using a thermostat for close control of the temperature to correspond with the momentary needs of the room it was found that in this particular case, with coke at $6.84 per ton and utilized in a hot-water-heating system, one could pay as high as 6.95 cents per kw-hour for electric energy.

In Sweden, where most electric energy is derived from water-power and sold at a price based on a fixed charge for a given demand and a very small consumption charge, there is a great field for heating during hours of light load, and to meet these conditions of operation various methods have been evolved for storing heat in masses of high heat capacity to be given off during the period of maximum load when the heating circuits are disconnected. Electric heat for holding boilers at boiling temperature is perfectly feasible in stations where a steam relay is operated in connection with a water-power.

Much has been done to perfect heating appliances and to devise ways and means of placing electric heating on an economical basis, but there is yet much to be done and the future for electric heating on a very large scale certainly looks bright.

The report was discussed by Messrs. Mengarini, Danioni and others.

INTERNATIONAL OUTLOOK IN SCIENTIFIC ILLUMINATION.

Mr. Leon Gaster presented a brief summary of a few of the most important problems in illuminating engineering which are now the subject of international discussion. He claimed that some generally accepted method should be adopted for comparing the color and daylight qualities of illuminants. It is also desirable that a definite and authoritative ruling be laid down regarding the amount of illumination demanded by different classes of work. It is desirable to adopt a truly international unit of candle-power, in order to avoid the confusion which exists at present by reason of the use of the hefner candle in addition to the so-called international candle. There should be international uniformity in methods of expressing and testing candle-power, in the measurement of illumination, in the units and nomenclature of illumination and in the designation of surface brightness and intrinsic brilliancy.

The author suggested that there should now be formed a truly international committee on which different systems of lighting should be adequately represented and in which representatives of bodies interested should also take part. This central committee might be aided in this work by sub-committees in various countries and would then be in a position to take up different points in an authoritative and permanent manner. The international photometric commission might well become the center of such a committee and

would co-operate with the Illuminating Engineering Society. It is desirable that the different commissions and bodies interested in illumination, which have heretofore worked on separate lines, should be brought into contact, with a view to concerted action. In this way uniformity in methods would be secured, and the results of researches in different countries would be rendered comparable with one another. The subject of illumination is assuming a prominent position in the field of industrial hygiene. Methods of lighting have a direct bearing not only on the eye, but also upon the general health, and the conditions of illumination have also an important bearing on the quality and output of work in factories. What is now needed is to determine the correct amount of illumination for various purposes, so that some tentative standard of good illumination may be arrived at and the study of illumination placed on a more scientific basis.

ELECTRIC PROPULSION OF SUBMARINES.

Present development in submarine navigation is due largely to the favorable characteristics of electric propulsion. Mr. Agostino Bezzi in a paper on the subject of electric propulsion briefly outlined some of the difficulties encountered, described ways and means that have been employed to overcome them and pointed out the most likely lines of improvement in the near future.

The battery question is of the greatest importance. This service requires batteries that take up the least space and possess the least weight per unit of energy that can be derived from them. Cost is a secondary consideration and energy efficiency is of little consequence.

A brief comparative study on various types of lead batteries and nickel-iron-alkaline batteries showed the latter to be far superior with regard to weight and volume per unit of energy and to be cheaper in first cost per unit of energy delivered during their useful life. In the application of batteries on submarines the matters of insulation and ventilation are of the greatest importance. It is desirable to use a high emf so as to reduce the size and weight of the electric equipment, but the atmospheric conditions are such as to make the insulation for voltages above 220 very difficult and for those above 440 quite impracticable. The ventilation requires the provision of a special plant for exhausting the gases, and this system still further complicates the problem of insulation due to condensation of sulphuric acid in the ventilation ducts and hoods. The alkaline battery offers much greater difficulties in this respect than does the lead battery. First of all, it requires more ventilation and, secondly, the ventilating system becomes entirely covered with a coating of carbonates, which are good conductors and thus render the insulation of the batteries extremely difficult. No satisfactory solution of this problem has yet been developed.

Naturally all motors are direct-current, and since the resistance of the propeller increases with the speed the shunt winding is always used and occasionally a compound winding is also used.

Rheostatic speed control is limited in range and inefficient, and regulation by varying the field strength, while good in efficiency, is too limited in its range of variation. The most successful methods of control employ two motors or a double-winding motor, the adjustment of speed being accomplished by a combination of field regulation and series-parallel control.

The efficiency of the motor equipment is of the greatest importance, since it has a direct bearing on the radius of operation of the submarine. It also is necessary to avoid excessive room temperatures due to heating of the motors. Artificial ventilation of the motors is very desirable, but exceedingly difficult of practical accomplishment. Air ventilation is too inefficient. The Siemens-Schuckert company has built a successful water-cooled motor.

The paper was discussed by Dr. Koloff and others.

HEAVY ELECTRIC TRACTION.

An analysis of single-phase and three-phase systems with a view to their application to heavy railroading was made by Mr. Giorgio Calzolari.

By way of introduction he summarized expert opinion on this subject by briefly reviewing the conclusions arrived at by the various commissions that have been appointed to investigate and study the subject. The preference of the various countries for one system or another as reflected in their present activities was then taken up and brief descriptions of electric-traction systems under construction in the various countries were given. This review seems to place Germany, Sweden and Austria on one side as favoring single-phase traction for general adoption in heavy railroad work, while Russia, France and Italy are opposed to standardization of any electric system at the present time and seem, if anything, to favor the three-phase system.

In studying the characteristics of the two systems the problem was divided into two parts, namely:

(1) The requirements of railway operation, viz.: (a) Sufficient starting and running torque; (b) ability to maintain schedule time; (c) multiple operation of motor cars or locomotives.

(2) Economy of operation in the following respects: (a) First cost of motive power plant; (b) simplicity and durability of the distribution system; (c) simplicity and durability of the electric equipment; (d) ratio of weight of motor equipment to torque and power; (e) energy consumption at locomotive and at power plant per ton-kilometer; (f) instantaneous power demands; (g) maintenance expense.

Both single-phase and three-phase motors are able to develop sufficient torque and power for heavy railroad work.

In regard to schedule speed the author looks upon the constant-speed characteristic of the three-phase motor as an advantage, and in comparing the induction motor equipped for either cascade or variable-pole operation with the single-phase commutator motor he is of the opinion that because of the variation of power-factor with speed the single-phase motor is more limited in its running speed than is the three-phase motor.

Multiple operation offers no difficulties with single-phase motors. It has been the general belief that because of their constant speed induction motors could not be operated in multiple on the same train without serious disturbances. However, actual experience has shown that no serious difficulty is experienced when two locomotives are attached to the same train even though one has new and the other old tires.

The question of first cost depends so extensively upon local conditions that it is difficult to show where either one of the systems has an advantage over the other in this respect.

The single-phase distribution system is clearly the simplest, and yet because of the extremely high tension on the working conductor the three-phase system with a much lower working emf has a greater factor of safety. As regards the motor equipment, the induction motor is simpler and more robust than the commutator motor, but both have a very short air-gap. Furthermore, the single-phase motor equipment weighs about 40 per cent more than a three-phase equipment for the same service, and because of this difference in weight the energy consumption per ton-kilometer is slightly in favor of the three-phase equipment, and if the three-phase system is operated with regenerative control the energy consumption at the power house is still further reduced. Regenerative control with single-phase motors is now being tried out on the Midi line in the French Pyrenees.

The three-phase system has an important advantage over the single-phase system in that it permits the running trains to feed energy back to a starting train, thus relieving the power house of excessive demands. The author estimates

that by suitable adjustment of the speed regulators the momentary demands on the power house of a three-phase system can be reduced by more than 30 per cent.

On the score of general maintenance the two systems are considered to be about equal. Summing up, the author thinks that the 10,000-volt, 15-cycle to 25-cycle, single-phase system is best adapted to long lines of moderate traffic and especially in cases where hydroelectric energy is developed exclusively for traction purposes, while the 3000-volt, 15-cycle, three-phase system is best adapted to lines carrying heavy traffic, and especially where there are heavy grades and long runs.

At the end of the paper the author gives a detailed description of the electrification of the Giovi lines with three-phase equipment.

The paper was discussed by Messrs. de Kando, Vallauri, Donati, Koronzai, Assadtchy, Mailloux, Eichel, Vicini, l'Hoest, Beckmann and Behn-Eschenburg.

SINGLE-PHASE TRACTION MOTORS.

A monograph on single-phase traction motors was presented by Dr. W. Kummer. Beginning with a statement that practically all electrical manufacturers who had earnestly studied the subject had adopted the single-phase system for heavy railroad work and that the motors now in use could be divided into three classes, namely: series, repulsion and repulsion with armature excitation, he then proceeded to give some of the mechanical characteristics of these motors.

Experience with steam traction has taught railroad engineers to require a driving motor that can develop a variety of torques at a given speed so as to be able to maintain the operating schedule; also one that can develop large torques at low speeds and two torques at high speeds so as to secure good economy of energy in starting and in operation over a road having grades.

These characteristics are fulfilled to a marked degree by all the single-phase motors, and in addition to this they may be arranged for regenerative control, an actual installation being under construction now in one of the lines of the Chemins de Fer du Midi, France. However, although regenerative control introduces certain complications in the equipment, it is quite feasible to utilize the motors for transforming the energy of retardation into electric energy which can be dissipated in a rheostat. This system is in use on the Valle-Maggia road. Following these general characteristics, the author took up in detail the relations between the motor torque and some of the principal dimensions. Using the following symbols, he gave formulas for the interrelations of the various quantities as represented by modern practice:

Normal motor torque in meter-kilograms	$= D$
Rotor diameter	$= D_a$
Gear ratio	$= U$
Drawbar pull per driving axle in kilograms	$= Z$
Diameter of the driving wheel	$= D_r$
Speed in kilometers per hour	$= V$

$D_a = 2.42 \times \sqrt{D}$, for gearless motors.

$D_a = 3.30 \times \sqrt{D}$, for geared motors.

Assuming one motor for each driving axle:

$$\left.\begin{aligned} Z &= 82.4 \frac{D_a}{D_r} \sqrt{D} \\ V &= 67.9 \frac{D_r}{D_a} \end{aligned}\right\} \text{ for gearless motors.}$$

$$\left.\begin{aligned} Z &= 30.3\, U \sqrt{D} \\ V &= 135.8 \frac{1}{U} \end{aligned}\right\} \text{ for geared motors.}$$

$\left.\frac{D_r}{D_a}\right\}$ being assumed as 0.5 for geared motors.

With reference to weights and torque, denoting:

Car weight in kilogram	$= G$
Car torque in motor-kilograms	$= D_f$
Adhesion weight in kilograms	$= G_a$
Adhesion coefficient	$= \mu$
Diameter of drives	$= D_r$

Thus

$$\frac{G}{D_f} > \frac{G}{G_a} \times \frac{1}{\mu} \times \frac{2}{D_r}$$

which for single-phase motors was about

$$\frac{G}{D_f} = 11 \text{ to } 13.$$

WORKING CONDUCTORS FOR ELECTRIC RAILROADS.

Mr. Gustave l'Hoest submitted a report on present methods of constructing working conductors for heavy electric traction, describing briefly the fundamental types of third-rail and the latest catenary constructions used on the high-tension single-phase and three-phase roads in Europe.

In conclusion he stated that the third-rail can be advantageously employed for direct-current traction where there are not too many switches and crossings. Its use is especially desirable in and around cities, where the unsightliness of the overhead construction is objectionable, and also on account of its non-interference with the clear view of signals.

On the other hand, high-tension systems are limited entirely to overhead distribution. With present-day methods no especial difficulty is encountered in handling emfs as high as can be utilized, and this with little or no fear of danger due to mechanical failure of any part of the line. However, the author notes a tendency on the part of some constructors to relax and take chances by employing a lower factor of safety.

HIGH-TENSION, DIRECT-CURRENT TRACTION.

In a paper entitled "Notes on High-Tension, Direct-Current Traction" Mr. Guglielmo Gyáros showed how, thanks to the commutating pole, the direct-current system has taken a new lease of life and will in all probability become the standard system for interurban and suburban lines.

The commutating pole has greatly increased the possibilities of commutation, and the high-tension motors equipped with these poles possess much better commutating qualities than do the ordinary low-tension motors. Experience has shown that high-tension motor brushes have an average life of between 200,000 and 1,500,000 motor-kilometers and that the motors will stand a momentary overload of 100 per cent without flashing over. The ordinary motor will flash over with an overload of 50 per cent.

As an example of the comparative cost of maintenance of single-phase and high-tension direct-current systems the author gave figures taken from the results obtained by the Washington, Baltimore & Annapolis Railway which were published in the *Electric Railway Journal*. It was the author's opinion that the single-phase system could compete with the high-tension direct-current system only when very high tensions were used on the working conductor. For example, he considered that on the basis of equal economy a 1000-volt direct-current system was equivalent to a 5000-volt or 3000-volt alternating-current system and that a 2500-volt or 3000-volt direct-current system was equivalent to a 15,000-volt alternating-current system.

There are now either in operation or under construction five important high-tension, direct-current lines in Hungary, and the author gave data regarding each one. These systems use the pantograph trolley with an aluminum contact bow. When used on catenary construction these bows have an average life of about 20,000 car-kilometers, but in ordinary trolley construction their life is much shorter.

Los Angeles Electrical Show.

The first electrical show to be held in Los Angeles, Cal., was opened on the evening of Nov. 25, and will be closed on Dec. 9, being open during that period, including Sundays, from 2 to 11 p.m. The show is in the Shrine Auditorium, which offers a floor space, including balcony, of close to 50,000 sq. ft. Both floors are completely taken up by the exhibitors, of which there are about fifty, representing all sections of the country. To interest the general public in the exposition, extensive advertising and display work was carried on for some weeks previous to the show in Central California, Nevada and Arizona, and special round-trip rates were offered by the railroads from these and other distant points. The Los Angeles Railway Company operates cars on a special schedule direct to the auditorium during the early portion of each evening. Considering that but five days was allowed the management and exhibitors to arrange the display before the opening night, owing to another attraction occupying the hall, much credit is due for the excellent showing made.

ILLUMINATION AND DECORATION.

The general design of decoration and lighting is pleasing and attractive, without any great spectacular effect. The arrangement is uniform with diversified features here and there among the different booths. The time of year being characterized by the Christmas spirit, the scheme of decoration anticipates to some extent the Yuletide period in the use of miniature Christmas trees, foliage and the like, all, of course, being in conformity with the lighting features.

The iron roof trusses are draped along the bottom chord with strings of evergreen. Along this trimming, at intervals of about 5 ft., 16-cp lamps of corresponding green color are hung. Inclusive of twenty-eight crystal chandeliers, each having ten lights, 2500 lamps, of the capacity noted, are installed. In addition the general lighting is augmented by seventy-two arc lamps.

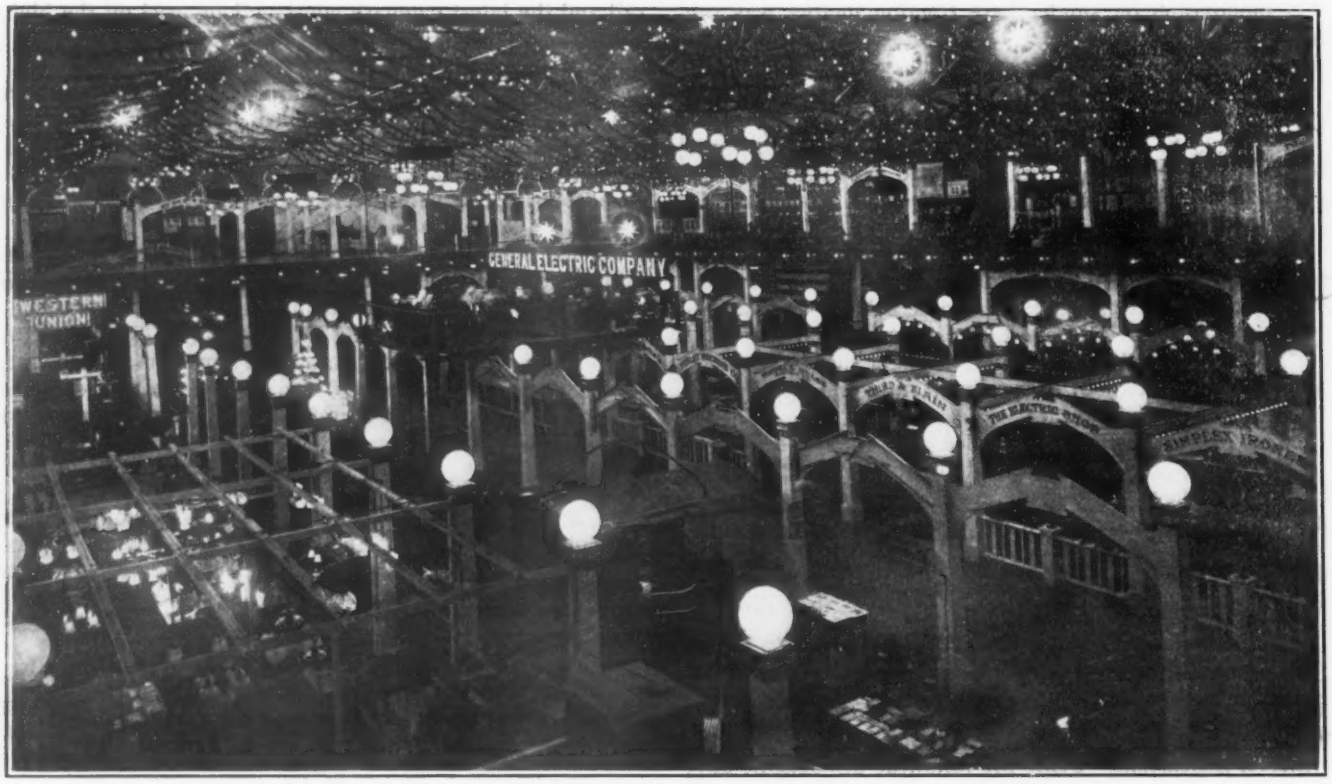
The booths are arranged at all four sides of the hall, with a double line of booths through the central portion of the main floor. These latter are divided by a 12-ft. center aisle. The front framework of the booths is of arch construction, with columns at intervals of approximately 10 ft., surmounted with lamps inclosed in white frosted globes. The booth framing is in white, with the name of the respective exhibitor stamped on the arch in blue and gold. The lighting for this decoration aggregates 50 500-watt, 50 250-watt and 170 100-watt lamps. The accompanying photograph, taken at the opening of the show, gives an idea of the illuminating features and general arrangement.

Many of the exhibitors displayed individual electric name and specialty signs, and added to the decoration of their sections small incandescent lamps strung along the struts and braces between the columns.

SPECIAL FEATURES.

The companies represented offered varied features to interest the general public and the student in electrical work, as well as the user of electric motors, the central-station man and the electrical constructor. For the former the application of electric energy to various forms of household appliances for reducing labor to a minimum, such as washing machines, electric irons, cooking appurtenances and the like, was attractively shown and demonstrated. The part that electric energy takes in the manufacture of food products and wearing apparel was also exemplified.

Among the individual exhibitors guessing contests were inaugurated, prizes of electric household utensils and similar specialties being offered to the successful contestants. The management offered cash prizes to the school children of Southern California for the best work executed and exhibited in plans and general drawings. Local orphan asylums were invited to send the children, gratis, and two special days were set apart to allow all school children, regardless of age, to visit the show at one-half the regular entrance fee. Dec. 1 was given over to the students of Throop Polytechnic Institute, Pasadena, and all the pupils of the Pasadena schools. Dec. 4 was devoted to the Merchants & Manufacturers' Association



General View of Los Angeles Electrical Show.

of Los Angeles. During the hours of the show musical concerts are given by the Catalina Band, one of the best organizations of its kind in southern California.

The show is given upon a co-operative profit-sharing basis. The net proceeds, after all expenses are deducted, will be divided among the exhibitors in proportion to the respective exhibit space occupied. It is confidently expected that the returns will more than repay each company for the initial outlay for space, which, it is stated, is lower per square foot than has ever been the case for a similar show held in a large city.

The exhibition is given under the auspices of the Los Angeles Electrical Exposition, an association of the leading electrical interests of the city. The entire executive committee, excepting the manager, gave its services freely. The committee is composed of Messrs. H. B. Woodill, chairman; C. S. Walton, vice-chairman; C. G. Pyle, secretary and treasurer; D. M. Moses, general manager; J. E. MacDonald, T. E. Burger, L. O. Lieber and W. B. Palmer.

For the operation of the different displays it was necessary to have electric energy in greatly varied classes of service, ranging from 500 volts direct current to 15,000 volts alternating current. Both two-phase and three-phase currents, at commercial voltages, were employed for many purposes. The electrical energy throughout was generally furnished by the Southern California Edison Company, except the 15,000-volt current, which was supplied by the Los Angeles Gas & Electric Company.

PUBLIC SERVICE COMPANY EXHIBITS.

The Southern California Edison Company, which furnishes electricity to a large section of Los Angeles and vicinity, had in operation a motor-generator set, this being used for supplying the direct-current motors at the exhibit, and an accompanying operating panel, regularly equipped; a mercury arc rectifier for magnetic street arc work was also shown. The company displayed one of its standard meter-testing outfits and explained its principle of operation. In addition, for the instruction of consumers there was illustrated, by means of five large dial faces and hands, the method of reading meters, an attendant marking on a blackboard each respective reading in kilowatt-hours as the hands were shifted to various positions. The exhibit was in charge of Messrs. C. S. Walton, G. E. Simpson and E. R. Stauffacher, all connected with the company.

The Pacific Electric Railway Company's exhibit was particularly attractive in being a reproduction of one of the cars regularly employed on the route. To effect this, the front of a red car, including nickel guard bars over the entrance, was placed upon one of the elevated platforms forming part of the sides of the main floor of the auditorium. The latter, representing the body of the car, was suitably draped along the side with a black field, supplemented by orange and red trimmings, at the center of which the familiar Pacific Electric cylindrical seal of black, white and red was placed. The interior portion of the suggested car was given over to free moving pictures and stereopticon views, there being a seating capacity of about 100 persons. This illustrated feature was devoted to travelogue talks of scenes along the route, and an account of the growth of the system from 10¼ miles of railway in 1893 to 970 miles in operation in 1911. The company also exhibited the Hunt "automatic flagman," which it employs at crossings. This was in direct charge of the inventor, Mr. Hunt, who explained the operation by means of a minature Pacific Electric car, operating on a track about 3 ft. long. The overhead wires of the diminutive railway were electrically connected to operate the regular relay used for the signal, with four contact points for starting and stopping the operation. An automatic block signal was also shown. The display was arranged by Mr. Edward C. Thomas, advertising agent of the Pacific Electric Railway Company, who represented the company at the show with an efficient force of assistants.

The Western Union Telegraph Company exhibited a typewriter-telegraph system, taking messages from the visitors and transmitting on the machine in full view. The company also displays its regular duplex and quadruplex instruments and some of the new features introduced for the convenience of the public. Old-type instruments, formerly in service, are exhibited. Mr. F. A. Bennett, commercial agent, and Mr. G. E. Palmer, district equipment supervisor, represent the company.

The Home Telephone Company, whose system was in service at the show, installed a cabinet panel exchange board with single operator and a regular sound-proof telephone booth for the convenience of those attending.

EDUCATIONAL AND SPECTACULAR.

The United States government has furnished an interesting and instructive exhibit, gathered from the National Bureau of Standards, the Weather Bureau, the Smithsonian Institution and the navy.

The Bureau of Standards presents many items of electrical and mechanical interest, including a potentiometer for calibrating measuring instruments, many standard electrical measuring instruments, a polariscope, standards of weights and measurements, as well as various capacity standards. A large map is exhibited showing the various states of the Union which have passed weights and measures laws and those states in which such law is contemplated, as well as the cities that have been inspected. Mr. Frank A. Wolff, Jr., of the bureau, is in attendance.

The Weather Bureau, through the courtesy of Prof. Willis L. Moore, chief of the bureau, offers an exhibit which is distinctly educational to the general public, indicating the extent of the work executed. Meteorological instruments showing the distance and velocity of the wind, range of sunshine, rainfall, temperature and the part that electricity takes in obtaining this data are displayed and explained. The booth is attractively dressed with storm flags, marine meteorological charts and a large photographic display of atmospheric phenomena. Mr. A. B. Wollaber, head of the Los Angeles district, represents the bureau.

The Smithsonian Institution shows many interesting models of pioneer electrical apparatus, illustrating the remarkable growth of the electric industry. Among the models shown are Henry's electromagnetic signaling apparatus (1831); Henry's reciprocating electromagnetic apparatus (1831); Henry's "Yale" magnet (1831); Morse telegraph register (1837); Page electric motor (1850); Wallace electric-light dynamo (1873), and Wallace arc lamp (1877).

The Navy Department exhibits its standard wireless-telegraph system, complete with sending coil, helix and spark-gap and detector. Miniature battleships, gunboats, torpedo boats, etc., are shown. Pulleys and mechanical equipment used in the service are attractively displayed. The department is represented by Messrs. J. J. Dowd, E. A. Wintermute and J. A. Aulbach.

Instructive displays for the general public were shown by the Los Angeles Creamery Company, which demonstrated the Burrell-Lawrence-Kennedy Company electric cow-milking machine with the aid of four cows; by the Los Angeles Silk Company, which showed a silk-weaving machine, electrically operated; by the Shredded Wheat Company, with its well-known model of the electrically driven wheat-shredding machine, and by the Globe Mills of Los Angeles, showing the application of electric energy to flour-milling products. The Los Angeles Electric Vehicle Company exhibited the Edison storage battery as an isolated electric-lighting plant for residential use.

Spectacular exhibits were given by Mr. W. B. Palmer with a Tesla high-frequency outfit. The display includes the lighting of incandescent lamps held in the hand and

similar "stunts." A reproduction of an electric chair, with lifting crown and appurtenances, was shown, in which Mr. Palmer subjected himself to a so-called voltage of 400,000. While under this action many "freak" antics were executed.

Mr. E. J. Rose also demonstrated with a 44-inch Tesla high-frequency outfit and a 30-inch Oudin high-frequency apparatus and with various classes of Röntgen ray apparatus, including a coin-operated machine of this latter character. Mr. Rose explained the effect produced by electric energy in different degrees of vacuum by means of a vacuum pump and glass vacuum tubes. The display was particularly attractive and the apparatus well demonstrated.

A list of the commercial exhibits is given on another page.

Petition for Changes in Treatment of Depreciation in New York.

A petition for permission to make changes in the uniform system of accounts, relating principally to the treatment of depreciation, has been filed with the New York Public Service Commission, Second District. The various companies which have joined in the petition to the commission ask for a hearing on the matter.

The petition states that, as a result of the experience with the system since it was prescribed by the commission on Oct. 21, 1908, certain modifications should be made and certain provisions not now in force should be incorporated. It adds that the tentative classification of accounts for electrical and gas corporations was submitted to meetings of representatives of companies and was then modified without further hearing before official adoption. The application, therefore, has reference to matters regarding which no previous hearing has been held.

Suggested change No. 1 would require the elimination of Rule 21, entitled "Particulars Required to Be Shown in Entries." This rule requires that every charge to a capital account shall show whether the thing in respect of which the charge is made is original capital or an addition, betterment, renewal or replacement. Experience has shown that many capital expenditures partake of the nature of all three of the capital divisions as specified by the commission. As an illustration a hypothetical case is cited. Paragraph 21, the petition states, has added greatly to the amount of accounting work. About forty-five capital accounts are provided, and as the charges to each account may be an addition, betterment or replacement, it means that the company must keep 135 accounts, for it would be impossible in the annual report to distinguish capital expenditures by these subdivisions unless records were made as the charges were met. Paragraph 16 is entitled "First Entries Must Enable Identification." This provides that throughout all capital accounts the first entry in respect of any particular thing shall describe it particularly so as to enable its identification, and if the purpose of the commission in dividing capital expenditures into additions, betterments and replacements is to enable it to review the character of the additions during the year to capital account, it seems to the petitioners that this purpose is fully accomplished by Rule 16, and that the companies could be relieved of dividing their capital expenditures as provided, and yet no element of supervision would be lost.

Change No. 2 would require the elimination of Rule 22 entitled "Betterments Involving Partial Destruction of Things Bettered." This rule is devoted entirely to the subclassification of capital expenditures known as betterments. If the suggestions for the elimination of Rule 21 are decided in favor of the petitioners, Rule 22 would also be eliminated, but even otherwise the petition declares that the rule, judged by itself, should be eliminated.

Change No. 3, as requested, is the modification of the account "fixed capital, at Dec. 31, 1908." This rule as drawn provides that the fixed capital of a corporation at Dec. 31, 1908, shall be carried in one account, and that the reserves for depreciation at the same date shall be carried in a separate account from similar reserves accumulated subsequent to that date. The rule infers that when any fixed capital goes out of service it must be identified as being part of the capital on Dec. 31, 1908, or as installed since that date. Instances are frequent where the cost of a thing may be represented by expenditures for construction prior to that date and for additions or betterments subsequent to that date. Identification of fixed capital as belonging to either of the two periods may not appear to be so difficult when the requirement is recent, but ten or twenty years from now the difficulty will be a real, if not an insuperable, one. It is not unreasonable to assume that of the "fixed capital at Dec. 31, 1908," some part will be in service as late as 1930, and, if then retired, another generation will have to apportion the depreciation as applying to either side of the controlling date Dec. 31, 1908. That a rule has been adopted does not, it seems to the petitioners, justify the act of drawing an arbitrary line through the company's financial history, on either side of which different treatment should be accorded transactions which are alike in their nature. The proposed modified rule continues the account "fixed capital at Dec. 31, 1908," but provides one reserve to which all depreciation is to be charged. If the amount to the credit of the reserve is not sufficient, the deficiency must be adjusted by a charge to surplus.

Change No. 4 is a modification of the account "accrued amortization of capital" intended to make the rule conform to the proposed modified rule in relation to "fixed capital at Dec. 31, 1908." The modified rule provides that the reserve accumulated for amortization after Dec. 31, 1908, shall be added to the reserve existing on that date, and that a corporation's history and practice may be continuous in this respect.

Change No. 5 is a modification of the account entitled "general office supplies and expenditures." An allied suggestion, change No. 6, is for a special account under "general and miscellaneous expenses," to cover rents of property used in connection with the operations of the company. No provision is made in the classification of operating expenses for the rental of property used for any other purpose than offices. Such rentals must now be charged as a deduction from income.

Change No. 7 is the proposed modification of the account entitled "general amortization—electric." The rule as now drawn leaves to the corporation the determination of the amount to be charged to operating expenses for amortization, except that whatever amount may be selected must not include expenditures for repairs. This latter provision is in conflict with the first part of the rule, in that it qualifies the action of the corporation to some extent. The petition recognizes that there is no question to-day but that depreciation is a fact, and that it must be cared for, and that there is a further consensus of opinion that depreciation must be made good out of earnings and that replacement of depreciated property must not be represented by new capital, but the method of arriving at the amount of depreciation is unsettled. Uniformity of practice among all corporations in relation to the determination of the amount to be reserved can never be accomplished. If depreciation were the result of wear and tear only, the problem would be a simple one, but depreciation arising from obsolescence and inadequacy can be determined only with the lapse of time. Apparatus that would be obsolescent in one locality would meet all the modern requirements in another locality.

The rules are seemingly based on the assumption that questions of amortization provision in all their bearings are settled. Literature on the subject contradicts this assumption. For the present, at least, corporations should be per-

mitted to accumulate their own reserves according to the methods which best suit the local conditions, and they should be allowed to do this with just as few restrictions as possible. The modified rule and notes in relation thereto suggested by the petitioners establish these as the practice. The requirements of the commission that amortization charges shall be so adjusted as to provide by the time structures go out of service a reserve equal to the original money cost thereof, less salvage, are not modified by the proposed changes in the rule, nor are there modifications of the requirement that such reserve be accumulated through the medium of operating expenses and that retired fixed capital is not to be replaced by the issue of new capital. The modified rule seeks to accomplish freedom on the part of the corporation in complying with these requirements, and, furthermore, that the amount reserved and the methods followed in determination of the amount may be reported to the commission after action has been taken, instead of in advance thereof.

The petition has been signed by the Westchester Lighting Company, the Northern Westchester Lighting Company, the Peekskill Lighting & Railroad Company, the Yonkers Electric Light & Power Company, the Municipal Gas Light Company of Albany, the Poughkeepsie Light, Heat & Power Company and the Syracuse Lighting Company.

Public Service Commission News.

NEW JERSEY COMMISSION.

During this week a hearing will be given by the commission to the electric-railway, electric-light and power and gas companies of the State on the adoption of a general balance sheet and income accounts and classifications of construction and operating accounts, and the hearing will be continued on complaints of Gateley and Hurley and others and the Board of Chosen Freeholders of Camden County versus the Delaware & Atlantic Telegraph & Telephone Company relating to rates charged for service; also, there will be hearing on the adoption by telephone companies of a general balance sheet and income accounts and classifications of construction and operating accounts.

NEW YORK COMMISSION.

The Richfield Springs Utility Company has been authorized to purchase the existing plant and distributing system of the Richfield Springs Electric Light & Power Company and to increase its capital stock to $20,000. The company is also authorized to make a mortgage upon all its property and franchises to secure an authorized issue of $100,000 par value of 5 per cent first mortgage thirty-year gold bonds. The company is authorized to issue capital stock to the amount of $13,600 and bonds to the amount of $34,000, to be sold at not less than 85, for the purchase of the properties mentioned and for rehabilitation of the plant at Richfield Springs.

MARYLAND COMMISSION.

Chief Engineer Charles E. Phelps, of the Public Service Commission, announced recently his intention of beginning very shortly a series of tests with the telechronometer, an instrument which, it is claimed, will accurately measure telephone service. At the same time he will test another instrument, manufactured by the same company that makes the telechronometer, which registers telephone service in a different manner. According to Mr. Phelps, the telechronometer is entirely unlike any instrument that has so far been invented for the purpose of registering telephone calls, as it measures the time of each call, and its adoption would mean, Mr. Phelps says, the revolutionizing of the present system of charging for telephone service. The other instrument to be tested simply registers the number of calls used.

MASSACHUSETTS COMMISSION.

The Gas & Electric Light Commission recently gave a hearing upon the petition of the Worcester Suburban Electric Company for authority to issue additional capital stock to the amount of $125,000 par value. A feature of the hearing was the testimony of President Philip Cabot regarding improvements in the central station in the valley of the Blackstone River. In the past nine months about $130,000 has been expended by the company in additions to plant, including the enlargement of a generating station at Uxbridge by the addition of a 1250-kw Allis-Chalmers turbine unit, with boiler capacity sufficient to run it at a full overload capacity of 1500 kw; the installation of condensers, exciters, transformers and a new intake. New substations have been built at Rockdale and Millbury, the latter being designed to replace a former substation in Grafton whose location menaced the regularity of service on account of its connections with various consumers in relation to the line. A new No. 0 three-phase, 11,000-volt copper line has been built from the Wexbridge station to Millbury, largely on private right-of-way. Local distribution at Millbury will be handled at 4000 volts instead of 2300 volts, on account of the relatively large area of distribution involved. The estimated cost of steam-plant extension was $100,000. The company now has franchises to serve territory extending up the Blackstone Valley to the city limits of Worcester. Mr. Cabot said that the territory in which the company is operating is growing rapidly, and that only a temporary depression has been felt in the manufacturing field, the company's earnings not being seriously affected at any time.

CURRENT NEWS AND NOTES.

LINE MATERIAL DESTROYED BY ATMOSPHERIC FUMES.—Special all-copper socket shells and line parts have been required in installing the new street-lighting system at Mineral Point, Wis., where the presence of a large zinc smelter produces fumes which rapidly destroy any brass part exposed to the weather. Twenty-five tungsten standard fixtures and 134 single lamps are now being placed for the public lighting, all-copper sockets being specified for all of this work. Porch lamps on houses are similarly affected by the zinc fumes, although the receptacles indoors appear to suffer less severely than those exposed to the outer air.

* * *

ELECTRICITY FOR CHICAGO'S NEW TUBERCULOSIS SANITARIUM.—Electric service for the new Municipal Tuberculosis Sanitarium to be erected at Bryn Mawr and North Fortieth Avenues, Chicago, near the northwest boundary of the city, will be furnished from the 12,000-volt transmission line of the Sanitary District of Chicago, which parallels the North Shore Channel of the Chicago Drainage Canal to the Evanston pumping station. A central power plant will distribute this energy to the numerous buildings of the institution, which will be built on the group plan, the power-house building containing the steam-heating boilers, sterilizing laundry, pumps, garbage crematory, refrigerating plant, and a 65,000-gal. water-storage tank in its tower. Pierce, Richardson & Neiler are the consulting engineers for the electrical and mechanical features. A small substation building 50 ft. east of the power house will contain the step-down transformers for reducing the 12,000-volt transmitted pressure to 440 volts for distribution about the grounds. Refrigeration from a plant in the power house will be distributed to cooling boxes in the buildings. The buildings will also be equipped with motor-driven vacuum cleaners. It is estimated that the buildings, sewerage system, electric lighting, piping, conduits, etc., will cost about $820,000.

Turkeys for Central-Station Men.—This year, as last, the Commonwealth Edison Company of Chicago gave a turkey at Thanksgiving to every man employed by the company for a year or more. About 2500 turkeys were required for this remembrance, which cost the company about $7000.

* * *

Meeting of N. Y. E. S.—At a meeting of the New York Electrical Society to be held in the Engineering Societies Building on Dec. 12 Dr. Louis Livingston Seaman, major surgeon First U. S. V. Engineers, will deliver an illustrated lecture on "A Scientific Hunting Expedition in Central Africa."

* * *

Wireless in Alaska.—At present the United States Signal Corps has nine wireless stations in Alaska, and a 10-kw station is being constructed. Two of the stations are being increased in capacity by the installation of 10-kw sets. The navy also maintains four stations in Alaska and neighboring islands.

* * *

Big Cut in Winnipeg Lighting Rates.—A dispatch from Winnipeg, Man., states that the city has definitely fixed the price of light and power furnished by the municipal plant at 3 cents per kw-hour, and that the private company will meet this cut. This new rate represents a reduction of 60 per cent from the rate in force prior to operation of the municipal plant.

* * *

Electrification of New Zealand Railroads.—In reply to an inquiry on the subject made by a deputation, the Minister of Public Works of New Zealand recently stated that the government has under advisement the eventual electrification of the entire state railroad system. Authority for electrification of a short line will be asked at the present session of the parliament.

* * *

Field for Electric Trucks.—The registered number of commercial automobiles of all types in New York State is about 8000, of which at least 50 per cent are used in Greater New York. It is estimated that during the hot days of last July 1600 horses died as a result of the heat during two weeks. The extra expense caused by such loss in summer and the inability of horses to make headway through snow in winter are rapidly proving to merchants that the automobile is more economical than the horse-drawn vehicle.

* * *

Commercial Acyclic Generators Dismantled.—The two 500-kw vertical turbine-driven homopolar generators in the plant of the Murphy Power Company, Detroit (described in the *Electrical World*, Sept. 1, 1910), the only acyclic direct-current machines in commercial lighting service, are now being replaced by 750-kw alternators on the same Curtis turbine frames. These homopolar generators produced 50 volts per single turn between collector rings when driven at 2000 r.p.m., their twelve sets of rings being so connected as to give 250 volts for the Murphy company's three-wire system.

* * *

Chicago Electric Club Affairs.—At the "get-together" meeting of the Electric Club of Chicago on Nov. 29 President Niesz gave a talk on co-operation among members to assure the continued success of the club. Mr. Frederic P. Vose, former president, made a thoughtful and eloquent Thanksgiving Day address, meriting once more the distinction of being the club orator. In discussing club affairs he urged the members not to "talk shop" too much at the meetings, but rather to lay aside usual topics two hours a week and either discuss subjects of broad general interest or enjoy the pleasure of social commingling. Mr. Albert Schieble took issue with this view. The club, he said, is distinctively an electric club, and the speaker made a plea for the discussion of topics relating to the wide sweep embraced in the science and art of electricity. Many other organizations give opportunity to debate questions of economics and sociology, he said. Let the Electric Club continue to attach predominant importance to electrical development.

* * *

Users of Commercial Power Vehicles.—Data as to the various services in which commercial power vehicles are used were compiled last winter during the national automobile shows. Cards left by more than 1500 visitors to the commercial-vehicle section of the Madison Square Garden Show in New York and about 1800 visitors to the corresponding section of the Chicago Show, all of whom were users of commercial power vehicles, were tabulated according to lines of business. Each of fifty distinct lines of business was represented by cards left by more than ten visitors to the shows. The building and contracting business led by a large proportion, equal to 7.7 per cent of the whole attendance. Manufacturers of metal goods were represented by 6.1 per cent; lumbering companies and retail yards by 6 per cent; canners, manufacturers of food stuffs, wholesalers and retail grocers by 6 per cent; printers and publishers by 5.1 per cent; machinery makers by 4.6 per cent, and general merchandise or department stores by 3.5 per cent.

* * *

Human Electricity.—A professor of electrical engineering recently received the following communication: "A question involving electric energy came before us today and, not being familiar with electrical matters, we decided to refer the question to you for information. A man makes the statement that every person is possessed of either positive or negative electricity or both, and that the amount of either can, by some electrical appliance now in use, be determined. He asserts that the greatest number of people are possessed of positive electricity and that one having negative electricity is rarely found. He says to determine if one has negative electricity a simple home test can be made as follows: From a green tree cut a small limb shaped like an inverted V and hold the ends one in each hand with the point upward. If the person holding the limb has negative electricity the moisture in the wood will act as a conductor, and as the person passes over water like a river or an underground stream the limb he holds will be attracted downward. What we wish to know is whether his assertions are founded on fact. Do people possess either positive or negative electricity, and is there any scientific method of testing the kind or quantity?"

* * *

Seattle Municipal Plant.—Advance sheets of the report of the lighting department of the city of Seattle for the year 1911 show that the total cost of the municipal light and power plant to date is $3,388,803. The present capacity of the plant is 16,000 hp, and bonds for $1,400,000 have been authorized for constructing a new dam whereby the water-storage capacity will be so increased as to give a generating capacity of 60,000 hp. An auxiliary plant of 4000 hp is being constructed, located centrally in the city, which will be operated by the overflow from the high-service reservoirs of the water department, that department being paid for the water so used. This will bring the capacity of the plant to 20,000 hp. The estimated revenue for 1911 is $850,000; expenses, including interest, $350,000; depreciation charge, $250,000—leaving a surplus of $250,000. It is stated in the report that the average business rate charged by the municipal plant is 3 cents per kw-hour, the average power rate being 2 cents per kw-hour. The residence rate is 7 cents for the first 60 kw-hours per month and 4 cents for all over that amount. Payment is received for city lighting as if furnished by a private plant: the rate is $54 per year for a 6.6-amp arc and $13.80 per year for 40-cp incandescents. The number of private customers served is 17,000.

ELECTRICALLY DRIVEN ICE-CREAM FACTORY.

Producer-Gas-Engine-Driven Plant of the J. M. Horton Ice Cream Company in New York City.

Direct-Current Commutating-Pole Motors Drive Ammonia Compressors, and Many Operations Hitherto Performed Manually Are Converted to Electric Drive—Up-Draft Suction Producers Burning Anthracite Coal Used.

THE J. M. Horton Ice Cream Company is reputed to be the largest manufacturer of ice cream in the country and maintains a number of factories in New York, Brooklyn and Jersey City. Its largest and most representative factory is located at 205 East Twenty-fourth Street, which is also the main office of the company. Here there has been installed a modern producer-gas outfit driving direct-connected generators the output of which is employed for lighting the building and for driving various machines used in the manufacture of ice cream and water ices.

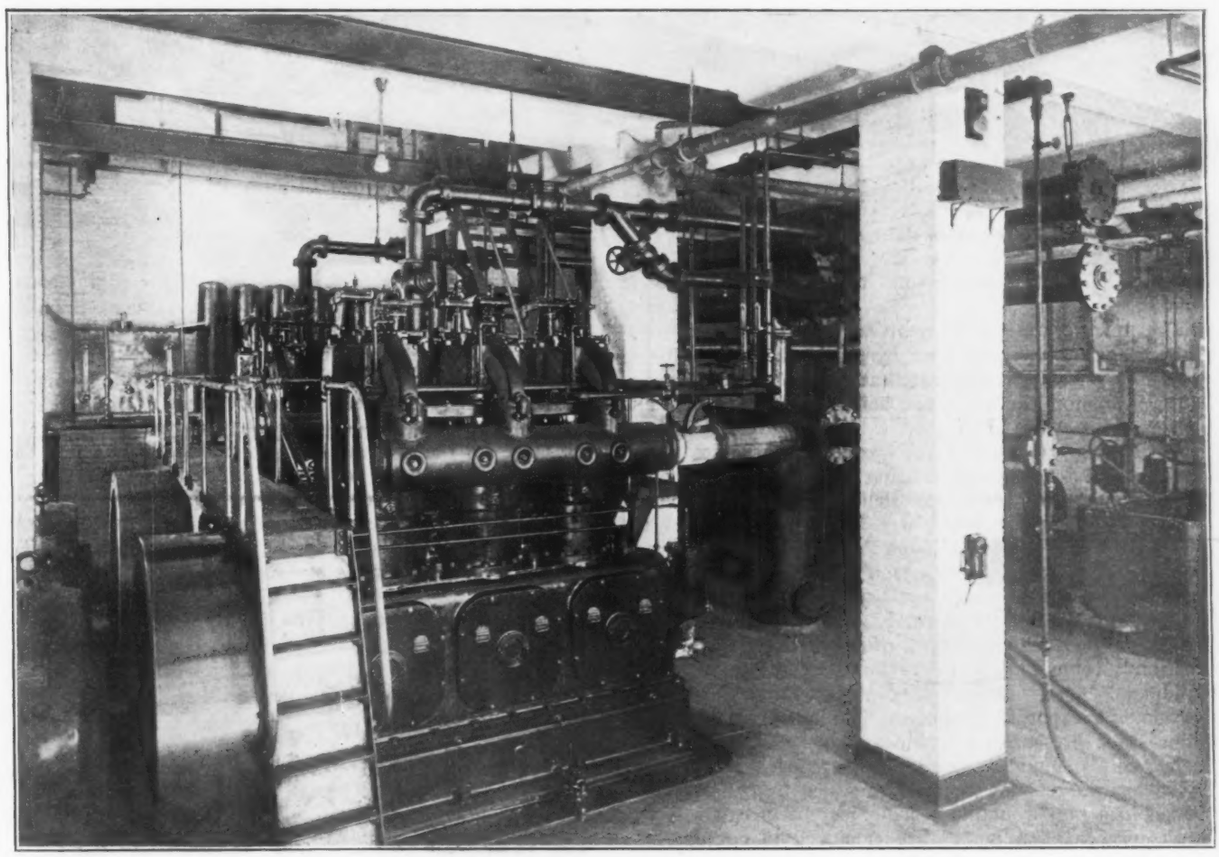


Fig. 1—Generating-Room; J. M. Horton Ice Cream Company.

Two up-draft suction producers with their scrubbers are located in a compartment on the floor above the engine-room. The producers, which were built by the Tait Producer Company, New York, are designed to burn anthracite coal and are rated at 350 hp. At present pea coal is burned on the grates. This is chuted from a bin on the third floor, where storage for about 175 tons is provided. The coal is brought to the plant in trucks and elevated to the third floor, while the ashes are removed from the producer-room in ash cans and carted away by the company's own wagons.

From the producers the gas is conveyed through dryers on the engine-room floor to the gas engines. A motor-driven blower is used in starting the producer, and duplicate piping is arranged so that the engines may operate with pressure gas or with suction gas. Pilot burners are provided in the producer-room to guide the attendants, and pilots are arranged on the engine-room floor for the benefit of the engineer. All valves in the producer-room are operated from the engine-room floor and are under the direct charge of the engineer, so that there can never be any question of mixed orders. At stated times during the day samples of the gas are taken from the producers in rubber bags and analyzed in an Orsat apparatus.

A certain percentage of the exhaust from the gas engines is returned to the ash pit of the producers, together with air sucked in the pipe on the way. The producers operate on the balanced-draft system, and pressure in the ash pit is used to balance that above the fuel bed. Although the producers are rated at 350 hp, they have been operated all summer under a 20 per cent overload.

The generating equipment installed in the engine-room comprises two 225-brake-hp Rathbun-Jones gas engines direct-connected to 150-kw General Electric generators wound for 250 volts. The engines are of the vertical three-cylinder type, and the ignition energy is obtained from a storage battery charged from a small motor-generator set. Each engine is equipped with a heavy flywheel, and the generators are fitted with slip-rings connected to auto-transformers used as balancers for a three-wire system. Energy at 125 volts is employed for lamp circuits and energy at 250 volts for all motor circuits.

For controlling the circuits a seven-panel switchboard is installed in the engine-room. The board is designed for the ultimate capacity of the plant, space being provided in the engine-room for an additional gas-engine set and also

for another refrigerating set. It is equipped with three generator panels, and the two panels on the extreme right carry the switches for the motor and lamp circuits. The circuits leading to the motors on the second and third floors of the factory have pilot lamps in them which are lighted while the motors are in operation. By this means the engineer knows just what motors are operating at any time. The wiring throughout the building is laid in conduit.

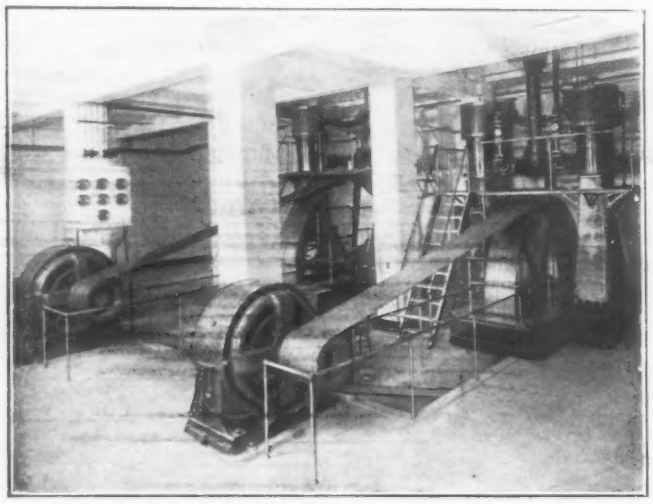


Fig. 2—Motor-Driven Refrigerating Machines.

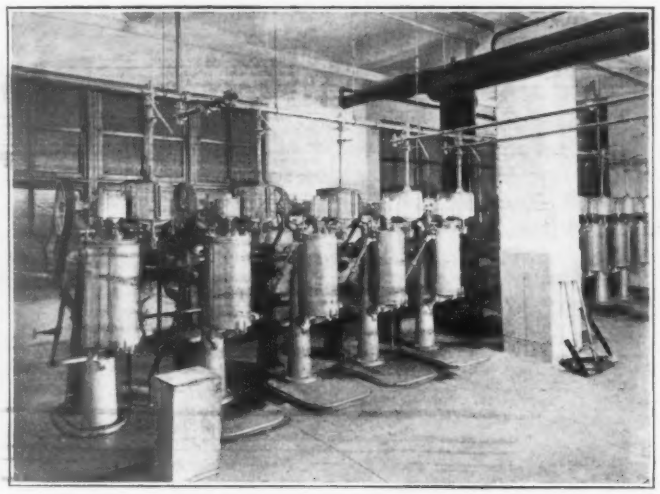


Fig. 3—Ice-Cream Freezers.

The refrigerating equipment at present installed consists of two compressors built by the York Manufacturing Company, one of which is rated at 75 tons and is belted to a 125-hp motor, the other one being rated at 50 tons and driven by a 90-hp motor. The motors are of General Electric make and are fitted with commutating poles. They are designed for a speed variation ranging from 250 r.p.m. to 500 r.p.m., the compressors delivering full rated output at the latter speed. The water from the jackets of the refrigerating machines and from the gas engines is pumped by a 10-hp turbine pump to a tank on the third floor of the building. Duplicate pumps are provided on this floor, one consisting of a 20-hp General Electric unit and the other of a 22-hp Allis-Chalmers unit, which force the water from this tank to a cooling tower built on the roof of the building.

Ammonia vapor is compressed in the refrigerating machines to a pressure of approximately 150 lb. per square inch, and the liquid ammonia thus produced is permitted to "evaporate" under reduced pressure in coils of pipe placed in a tank containing brine for the circulating system. Motor-driven pumps are employed to circulate the cold brine. A turbine pump rated at 800 gal. is driven by a 35-hp adjustable-speed motor and supplies the brine for cooling one of the large chill-rooms on the second floor in which ice cream is set to harden after it leaves the freezers. In addition a 400-gal. pump driven by a 15-hp motor supplies brine to the ice-cream mixers, freezers and a small chill-room on the third floor. The freezers on the second floor are provided with clutches on the main shaft for individual control, the group being driven by a 20-hp motor. In addition there are a 10-hp motor driving the French freezers on the second floor, a 10-hp motor operating ice crushers and conveyors, a 7.5-hp motor connected to an ice hoist and two 7.5-hp motors connected to bunker-room fans in the cold-storage rooms.

On the third floor of the factory, in addition to the motors driving the pumps for elevating the jacket water to the cooling tower on the roof and the 15-hp motor driving the brine circulator, there is a 7.5-hp motor connected to ice-cream freezers and a 5-hp motor driving cream beaters, etc.

Aside from the more sanitary conditions brought about by motor-driven apparatus, experience is said to have demonstrated that ice cream of superior quality is obtained, this being due to uniformity of freezing.

In addition to supplying refrigeration to the ice-cream freezers and storage rooms on the upper floors, during periods of light load the compressors operate in connection with a tank ice plant in the basement off the engine-room, where 30 tons of ice can be made daily. The ice is pulled from the tanks by a Sprague hoist.

When the plant was erected a short time ago it was estimated that sufficient overload capacity had been provided to meet requirements for many years to come. However, as soon as it was completed it was found to be none too large for the growing business, and last summer it was operated on overload continuously. As indicative of the economy of the combined equipment it is stated that, when loaded, a kilowatt-hour was produced at the switchboard for the expenditure of 1.65 lb. of coal in the producer. A good average figure is stated to be 1¾ lb. of coal per kw-hour.

The building throughout is lighted by tungsten lamps fitted with prismatic glass reflectors, the lighting installation having been supervised by the National Electric Lamp Association's engineering department.

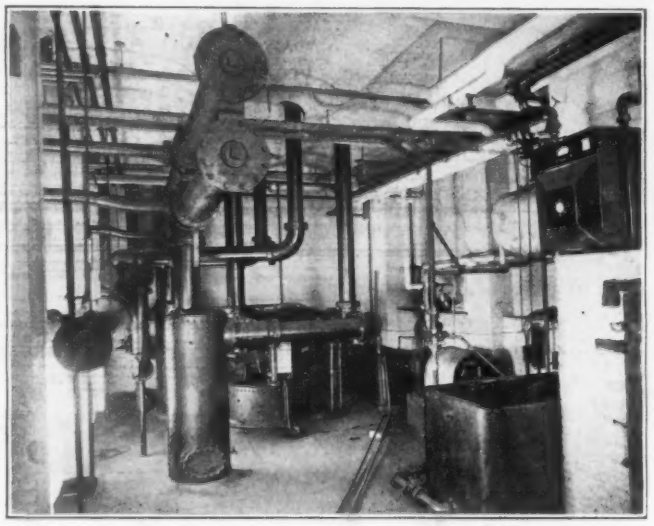


Fig. 4—Producer-Gas and Exhaust Piping in Engine-Room.

Messrs. Wallis & Goodwillie, of New York City, were the architects who designed the building and its equipment.

THE GENERATING AND TRANSMISSION SYSTEM OF THE TELLURIDE POWER COMPANY—III.

Logan, Jordan Narrows and Battle Creek Water-Power Stations of Utah System—Waterwheel Arrangement with Twin Runners Operating Under Different Heads.

IN previous issues a complete description has been given of the Colorado system of the Telluride Power Company, a general outline of the Utah system and a description of the Grace plant of this system. Some other plants of the Utah system are described in the following article.

LOGAN STATION.

The Logan plant is located 56 miles south of Grace station and 72 miles north of Salt Lake City, on the Logan River, and about 3 miles from the city of Logan. A timber crib dam, 10 ft. high, 112 ft. long at the top and with a 72-ft. spillway, diverts water from the river about 2 miles above the plant into a tapering intake about 80 ft. long, with a connection at the end to a 5-ft. x 6-ft. wooden flume equipped with four screens and lift gates. The flow line extends for a distance of about 10,000 ft. to an enlarged section designed to hold sufficient water to make the handling of peak loads easier, a spillway having also been provided to dispose of the water accumulating at periods of light load.

The station is located on the bank of the river below the penstock intakes. There are two units in the installation, each being supplied with water from an independent penstock 44 in. in diameter and from 331 ft. to 358.5 ft. long. Two exciter penstocks are also provided, each being 10 in. in diameter and 345 ft. in length. The effective hydraulic head under which the turbines in the station operate is 208 ft.

EQUIPMENT.

The machinery is housed in a 40-ft. x 80-ft. brick building, with masonry foundations. The interior arrangement illustrates the straight-line design from waterwheels to outgoing leads, but in this plant the high-tension lines are paralleled upon a common busbar outfit receiving energy from either or both generators at will. The turbine equipment consists of two 1500-hp Leffel machines of the double-runner type, each being connected through flexible couplings to a 1000-kw, 1150-volt, three-phase, revolving-field General Electric generator operated at 400 r.p.m. Two Lombard "Type H" hydraulic governors are installed for speed regulation. Two 30-kw, 125-volt exciters are also provided, these being driven through flexible couplings by six 11-in. Leffel turbines mounted in two sets of three each and supplied with water through triple nozzles.

The switching equipment of this plant includes manually controlled oil switches of the automatic type in both the generator and the transformer circuits, open fuses being used on the outgoing lines to handle circuit openings in case of emergencies. Low-tension leads are carried under the floor from the generators to the oil switches, the busbars for the 1150-volt system being copper bars set in fiber insulators. The connections between the oil switches on the low-tension side of the station and the step-up transformer installation are placed in concrete trenches, coverings being provided on top of the latter to protect the wiring runs. A 17-ft. x 25-ft. brick substation is in service near the main plant in connection with the local electrical supply to the town, including street-railway, lighting and small-motor service. A seven-panel switchboard 17 ft. long is located in the center of the operating-room

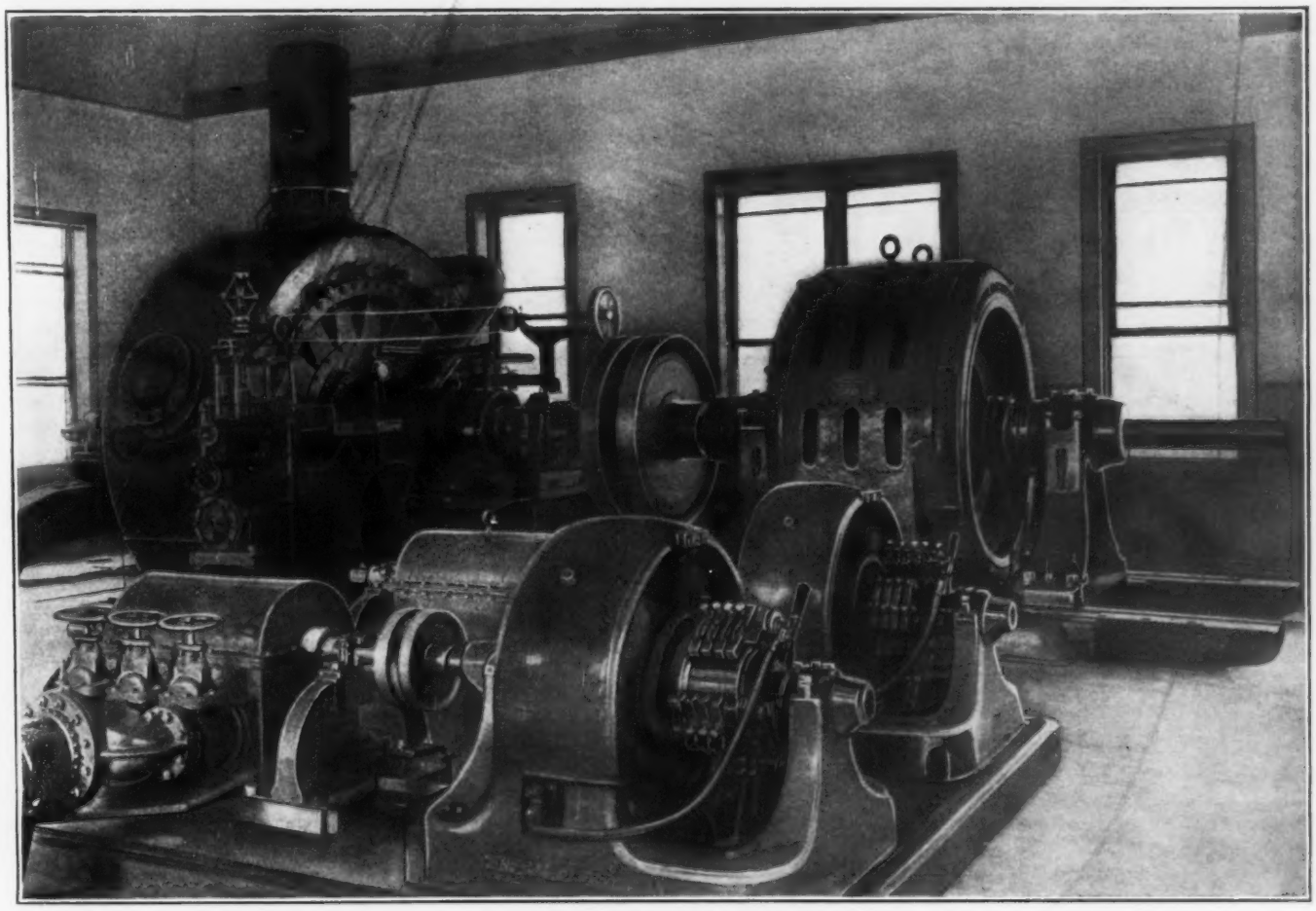


Fig. 21—Interior of Logan Station.

floor, the low-tension oil switches being mounted on the rear of the panels in an inclosed compartment.

SWITCHING.

The switchboard layout comprises two generator panels, one exciter panel, one bus junction panel for multiple operation, one transformer panel and two low-tension feeder panels. Beyond the low-tension oil-switch compartment on the floor of the operating room are installed a bank of six 333-kw water-cooled Converse transformers, a spare one also being available. The individual transformers have a voltage ratio of 635 to 23,132, but the company has connected them with the low-tension windings in parallel star with the neutral grounded and the high-tension windings in series delta, giving a ratio of 1100 volts to 46,000 volts for the set of six units. The outgoing leads from the transformers are connected to a set of three-phase busbars located about 16 ft. above the floor on a varnished wooden framework and glass insulators, paraffined wooden pins being employed at the supporting points. After passing through disconnecting switches and fuses the circuit is dropped to a 44,000-volt, three-phase oil switch mounted in a brick cell at the extreme end of the station, next the wall. There is one outgoing line with an oil switch and a disconnecting switch, and the mechanical handling of the switch is effected from a platform of varnished wood mounted on glass insulators, with stairways rising to a convenient height above the floor. The outgoing line is equipped with six spiral choke coils in series in each phase, and an installation of aluminum-cell lightning arresters provided with the usual disconnecting switches on the bus side. The station outlets are carried through open windows, a 5-ft. roof extension providing the necessary rain and snow protection. A 10-ton Whiting hand-operated crane serves the entire plant, and a small machine shop about 20 ft. x 13 ft. in dimensions occupies a bay near the transformer end of the station.

Fig. 22—Logan Station and Penstock.

JORDAN NARROWS STATION.

The Jordan Narrows station is a plant purchased from other interests about five years ago, its erection dating back about twelve years. This installation has a rating of 1000 kw in two 500-kw units, and takes its water from the Jordan River at a diversion point about 2.5 miles above the station, which is located in a narrow gorge of the river about 20 miles south of Salt Lake City. The principal hydraulic features of the plant are a dam of timber-crib construction at the diversion point, the height being 7 ft., an intake and a canal 13,000 ft. long, terminating at a 45-ft. x 55-ft. x 12 ft. concrete forebay, from which two 6-ft. steel penstocks 260 ft. in length carry the water to the turbines. The canal has a cross-section of about 6 ft. x 10 ft., and at its head the usual screens and gates are installed. Tapering openings in the floor of the forebay discharge the water to the penstocks, each of which is provided with a 7-ft. cylindrical valve of the hand-operated type.

The station is a 27-ft. x 82-ft. brick structure of simple rectangular shape, the roof being of concrete, reinforced with steel I-beams. The plant is laid out to permit doubling its equipment without increasing the size of the building.

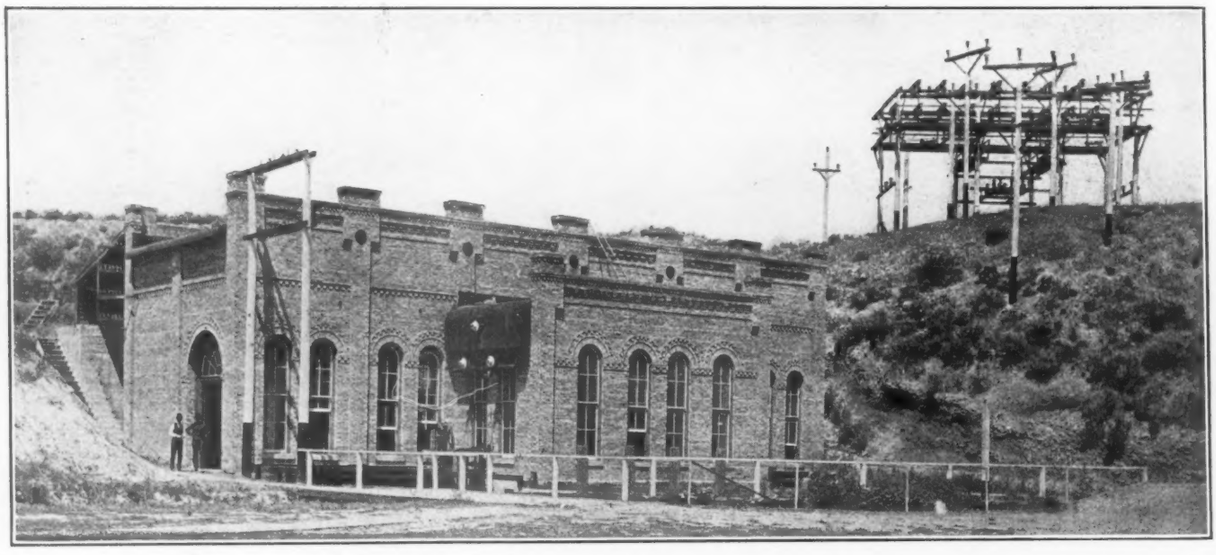


Fig. 23—Exterior View of Jordan Station.

the present equipment occupying one end of the operating room, with the exciter sets in the center. The electrical apparatus is installed on a switchboard opposite the exciters and in a 15-ft. x 30-ft. bay immediately behind the switchboard. The hydraulic installation at Jordan Narrows is peculiar in that one set of runners for each

turbine discharges through a draft tube about 28 ft. long into a tunnel outside the plant leading into the river below, while the other set discharges its water through a 9-ft. tube into an irrigation canal located on the further side of the station. In other words, each wheel consists of two different runners, one operating under a head of 55 ft.

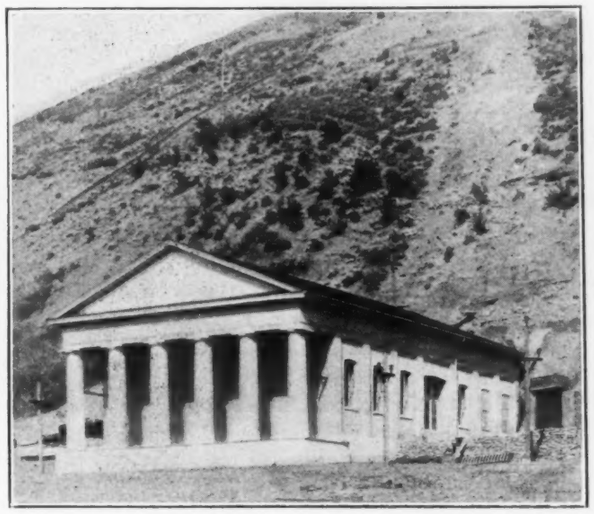


Fig. 24—Battle Creek Station.

and the other of 75 ft. Each runner develops 325 hp under its rated head, and the full load on the plant requires a water consumption of 256 cu. ft. per second. The wheels are located just outside the operating room, the generators being directly driven through shafting extending into the station from the wheel casings. Cylindrical sliding gates are installed at each wheel, the operation being either by hand or by two Replogle governors. The latter are ordinarily idle, as the speed variations are handled by the plants at Logan and Olmsted. The exciter turbines, rated at 40 hp each, are supplied with water by branch pipes leading from a 24-in. overhead main carried across the side of the operating room from the penstocks.

The generators at Jordan Narrows are 500-kw, 500-volt, three-phase Westinghouse alternators, with revolving armatures, each directly driven by an S. Morgan Smith wheel of the type mentioned above. The exciter wheels are also of the foregoing make, and the exciters are rated at 30 kw each. The main units operate at 300 r.p.m., and the exciter speed is 1050 r.p.m. From the generators the energy is led under the floor in fiber conduit to a five-panel switchboard, composed of two generator panels, one exciter panel, one transformer panel and a reserve panel. The operating transformer equipment consists of three 250-kw Converse water-cooled units located in the bay above referred to, the primaries being connected in delta and the secondaries in star. The plant contains no oil switches, the 44,000-volt circuit being broken only in emergencies by switches of the sliding air-break type. In ordinary operation the circuit is broken on the 500-volt side of the station. Fuses are installed in each of the outgoing conductors, the line passing directly from the station through outlet bushings of fiber insulating compound to an open-air switchrack connecting with the trunk and branch transmission-line system. Spiral choke coils and multigap lightning arresters are in service, these being mounted on a rack in the transformer bay near the outlet bushings.

BATTLE CREEK STATION.

Unlike most of the plants of the Utah department, this station is provided with storage facilities, which are capable of delivering 11,000 hp-hours on the peak of the load. The station is located at the bottom of Battle Creek Canyon, 2.5 miles from Pleasant Grove, and has a generating rating of 2400 kw in a single alternator driven by two waterwheels of the Pelton type, operating under a net head of 1630 ft. Two reservoirs are in service in connection with the plant, one having a capacity of 276,000 cu. ft. and being used for storage, and the other, an equalizing reservoir, having a capacity of 425,000 cu. ft. The water diversion is accomplished by a masonry dam 15 ft. high and 25 ft. long, situated about 3 miles above the station, there being a flume of 24-in. wooden-stave pipe between the dam and the storage reservoir, the length of the flume being 2 miles and the diameter inside 24 in. The flume is composed of fifteen parallel staves 1.5 in. thick, secured by iron bands spaced 18 in. apart, and bolted at each end to metal shoes fitting the circumference of the pipe.

EQUIPMENT.

From the storage reservoir the water is carried to the station by a steel penstock 4963 ft. in length, the diameter varying from 30 in. at the upper end to 20 in. at the lower. The upper third of the penstock is provided with riveted joints, the lower section being of lap-welded imported pipe. The station building is a 32-ft. x 80-ft. brick structure, with pillared portico serving as a weather protection for the outgoing circuits, masonry foundations being used for the building and machinery. Concrete floors and interior portions render the plant fireproof. The plant contains a three-phase General Electric revolving-field alternator, directly driven at 300 r.p.m. by a pair of 10-ft. wheels of 2000-hp individual rating, the unit being mounted on a horizontal shaft and provided with two Pelton deflecting nozzles, operated hydraulically and with needle-valve hand control

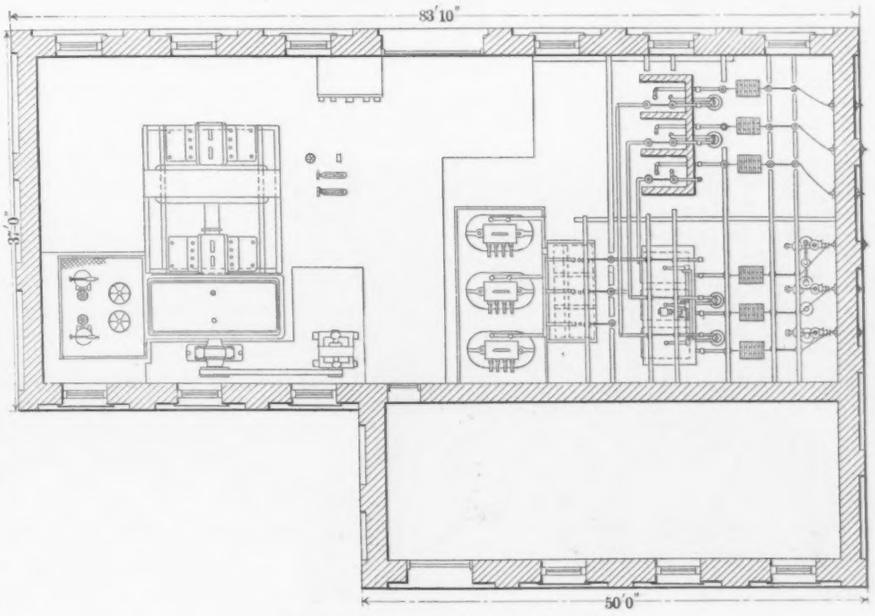


Fig. 25—Plan of Battle Creek Station.

at the nozzles themselves. A belt-driven exciter of 30-kw rating, wound for 125 volts and making 700 r.p.m., is installed near the generating unit. The plant illustrates again the straightforward design of the company's later stations, there being an installation of three 1000-kw, 2300-44,000-volt General Electric transformers of the water-cooled

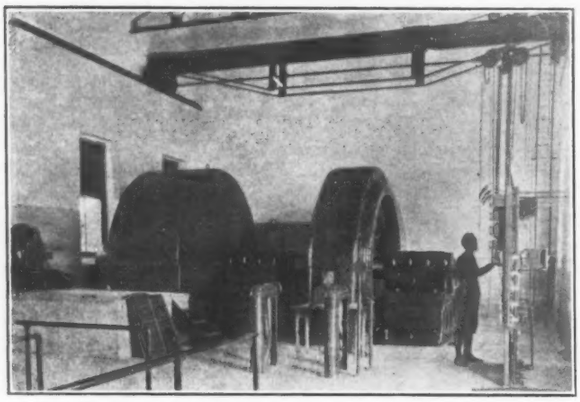


Fig. 26—Interior of Battle Creek Station.

type located beyond the main floor of the generator room and somewhat below it, with high-tension switches, wiring and lightning-arrester equipment at the end of the building most remote from the entering water supply.

WIRING.

The operating switchboard consists of a three-panel equipment mounted near the station wall on the generator side, this being equipped with one panel for generator service, one for the outgoing lines and one for instruments. The low-tension panel is provided with mechanical control through levers of the oil switch that is required in the generator circuit, remotely controlled apparatus operated by exciter current being installed in connection with the 44-000-volt line oil switches. The low-tension switch is located in the basement of the station, and the high-tension switches, of which three are in service, are located in the transformer bay at the end of the operating room. The connections provide for the operation of the transformers upon a single set of high-tension busbars through a solenoid-operated oil switch and disconnecting switches.

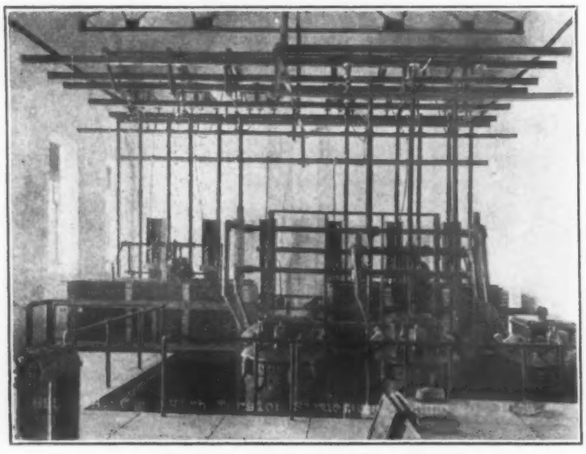


Fig. 27—High-Tension End of Battle Creek Station.

Two three-phase outgoing lines leave the station for Jordan Narrows and Olmsted respectively, and either line may be operated upon the bus if desired, or the line can be looped through on the bus in case the generating unit is shut down. The outgoing lines pass through a motor-operated oil switch in each case, disconnectors also being provided on each side of these. The transformers are connected in delta on both the primary and the secondary sides. The oil switches in the outgoing lines are provided with inverse time-limit relays.

The lightning protection includes six spiral choke coils per phase and a set of aluminum-cell arresters. Horn gaps are installed on the lines outside the building, with grounding device operated mechanically by hand from the station. Fiber conduit outlet bushings with insulated compound filling are used.

In following issues will be described other stations of the Utah System, future developments and system of transmission.

THE CHARACTERISTICS OF SERIES INSTRUMENT TRANSFORMERS.

Determination of the Effect of the Magnetic-Circuit Characteristics on the Current Ratio and Time-Phase Displacement.

By Arthur P. Young.

During the past few years series transformers have come into extensive use, more particularly in conjunction with certain types of alternate-current measuring instruments, such, for instance, as wattmeters, ammeters and power-factor indicators. As a consequence much has been written on this subject in recent times.

The subject is important because in all cases where measuring instruments operate in conjunction with series transformers the degree of accuracy obtainable with any given combination is not only dependent on the characteristics of the instrument itself, but, as will be shown below, to a very great extent on the characteristics of the series transformer or transformers with which the particular instrument is working.

While very rigid specifications, such as those compiled by the British Engineering Standards Committee, giving the permissible limits of error in single-phase integrating and indicating instruments, are enforced by supply-station and consulting engineers, thus insuring that a superlative standard as regards both accuracy and workmanship will always be maintained for this class of apparatus, no mention is made of series transformers in either of these specifications. This would seem to indicate that too little attention has been given to this particular point in the past, no doubt accounted for by the fact that the majority of supply engineers do not realize to just what extent the accuracy of their measuring instruments is dependent on the series transformers with which they are used, in cases where the latter are a necessary adjunct.

It would, therefore, seem that an article dealing with this particular aspect of the problem of series transformers would be of interest to supply-station engineers, and it is thought that it might not be unwelcome to all designers and manufacturers of these classes of apparatus.

There are two effects which should be considered, namely, the variation of the ratio of primary to secondary current with the load and the variation of the phase displacement between the primary and the secondary currents with the load.

The first of these will here be termed the "ratio characteristic" and the second the "phase-displacement characteristic." It is quite apparent that if one could build a perfect series transformer—that is, one in which, firstly, the ratio was constant for all loads, and, secondly, primary and secondary currents were always exactly opposite in phase to each other—the characteristic of any measuring instrument operated from it would not be affected in the slightest, no matter how the current or power-factor varied.

This, however, cannot be done, and as a result errors do

arise in actual practice, and if the "ratio" and "phase-displacement" characteristics of the series transformer corresponding to the actual working conditions are known, the extent of these errors can be accurately computed. The determination of these two characteristics can, of course, be done experimentally, and several methods[1] have been devised by means of which very accurate results can be obtained, provided a fully equipped laboratory is at the disposal of the experimenter, because all of these methods are suited only for the laboratory and could not be carried out in the commercial test-room. For this reason it is doubtful whether there are many manufacturers of series transformers who have made careful and accurate tests on their own productions with a view to determining their essential characteristics.

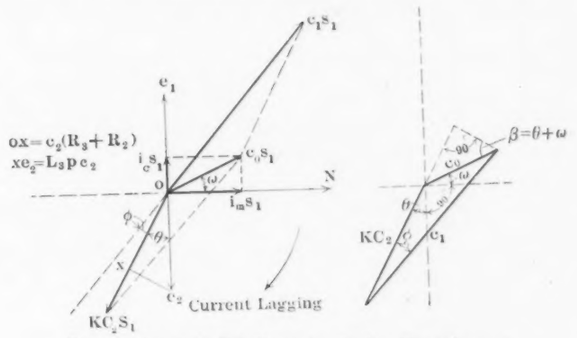


Fig. 1—Current Relations in Series Transformer.

There is, however, another method by means of which the same results can be achieved, and that is by calculation. The object of this paper is to give the results of the author's labors in this direction. He has constructed numbers of curves which can be applied to all types of series transformers in which the iron core is built up from "stalloy" punchings, the reason for choosing this particular brand of iron as a basis for the calculations being that it is used extensively in this class of apparatus. By the aid of these curves it is possible to plot the "ratio" and "phase-displacement" characteristics for given working conditions, provided the linear dimensions of, and the electrical data relating to, the series transformer are known.

A brief study of the method adopted in building these curves up from the permeability and core-loss curves for "stalloy" iron will make it quite clear that exactly the same procedure could be employed for any other brand of iron, and provided the permeability and core-loss curves are known a series of curves exactly similar to those given in this article could be easily made out.

ANALYSIS OF FUNDAMENTAL CHARACTERISTICS.

Assuming that

S_1 = primary turns.
C_1 = primary current.
S_2 = secondary turns.
C_2 = secondary current.
i_mS_1 = magnetizing ampere-turns.
i_cS_1 = core loss ampere-turns.
C_0S_1 = resultant of i_mS_1 and i_cS_1.
ω = phase displacement between C_0S_1 and i_mS_1.
e_1 = induced voltage in primary.
e_2 = induced voltage in secondary.
θ = phase displacement between C_2 and e_2.
ϕ = effective phase displacement between C_1 and C_2.

That is, with reference to the primary, the secondary current is equivalent to a current equal to C_2, and *leading* the primary current C_1 by a small angle ϕ.

K = theoretical ratio $= \frac{S_2}{S_1}$ $\qquad K_a$ = current ratio $= \frac{C_1}{C_2}$

The relationship between primary and secondary currents is shown vectorially in Fig. 1.

The author has shown elsewhere[2] that if there were no magnetic leakage between the two windings the current ratio would be given by the following expression:

$$K_a = \frac{C_1S_1}{C_1S_1 - C_0S_1 \sin\beta} \cdot K \qquad (1)$$

where,

$$\beta = \theta + \omega.$$

Also, $$\phi = \frac{C_0S_1}{C_1S_1} \cos\beta, \text{ radians,}$$

that is, $$\phi = 57.4 \frac{C_0S_1}{C_1S_1} \cos\beta \text{ degrees.} \qquad (2)$$

Before one can calculate K_a or ϕ for any particular case it is apparent that he must know the values of three quantities, namely, C_1S_1, C_0S_1 and β. The first of these is simply the primary ampere-turns, and for a given primary current can be easily calculated. C_0S_1 and β, however, cannot be determined until one knows the magnetizing and core-loss ampere-turns corresponding to the particular value of the flux density at which the iron core is being operated. This computation would have to be made for different values of the primary current taken over the whole range before the current ratio and phase-displacement characteristics could be plotted, so that of necessity the process would be laborious.

However, the process can be simplified considerably if only 1 cm length of the iron core be considered, because both C_1S_1 and C_0S_1 will then express ampere-turns per centimeter length and C_0S_1 per centimeter length and β are dependent simply on the value of the flux density in the iron core. That is, in a number of series transformers having cores of different dimensions, provided the same iron is used throughout, and the flux density in each is the same, the values of C_0S_1 per centimeter length and β corresponding to this state of affairs will be identical in each. The result would not be altered if the primary and secondary turns on each transformer were different and they were operating on various frequencies and under different load conditions.

Magnetizing Ampere-Turns i_mS_1.

Assuming a sine wave for the distribution of current and denoting the root-mean-square ampere-turns per centimeter length of the magnetic circuit by a, there is obtained:

$$i_mS_1 \text{ per centimeter} = a = 0.563\,H \qquad (3)$$

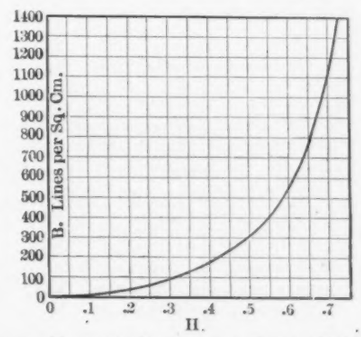


Fig. 2—Magnetization Curve of Core Material.

Fig. 2 shows the *B-H* curve for "stalloy" iron corresponding to a range of B from 0 to 1400 lines per square centimeter. In a well-designed transformer the range of

[1] See "Some Measurements on Phase Displacements in Resistances and Transformers," by C. V. Drysdale, D. Sc., Lond. *Electrician*, Nov. 23, 1906; "Determination of the Constants of Instrument Transformers," by P. G. Agnew and T. T. Fitch, *Electrical World*, Oct. 28, 1909; "Current Ratio and Phase-Angle Test of Series Transformers," by H. S. Baker. *Electrical World*, January 26, 1911.

[2] See "The Theory and Design of Current Transformers," by Arthur P. Young. *Journal* of the British Institution of Electrical Engineers, Vol. 45, 1909, page 674.

induction in the core between no-load and full-load will lie within these limits. The curve is an actual test curve kindly sent to the writer by Messrs. Joseph Sankey & Sons, Ltd., Bilston, the suppliers of "stalloy" iron.

Investigation shows that an approximate law can be deduced for the curve, this being of the form $H = k \cdot B^n$.

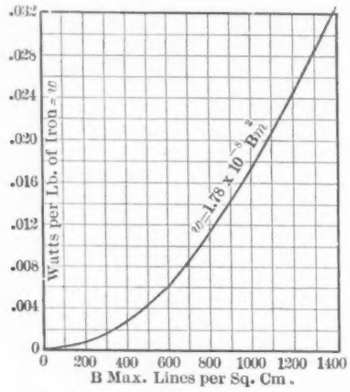


Fig. 3—Total Loss Curve for Core Material.

By assuming that the curve changes at a value of $B = 150$, the curve can be expressed by means of two equations, one covering a range of B from 0 to 150 and the other corresponding to higher values of B between 150 and 1400.

The expressions are as follows:

$$B\text{'s } 0\text{-}150 \ldots H = 0.0174\, B^{0.62} \quad (4)$$

$$B\text{'s } 150\text{-}1400 \ldots H = 0.97\, B^{0.28} \quad (5)$$

If plotted it will be found that the combined curves agree very closely with the actual test curve shown in Fig. 2.

Substituting in equation (3),

$$B\text{'s } 0\text{-}150 \ldots a = 9.8 \times 10^{-3} B_m^{0.62} \quad (6)$$

$$B\text{'s } 150\text{-}1400 \ldots a = 5.46 \times 10^{-2} B_m^{0.28} \quad (7)$$

B_m representing the maximum value of the flux density.

Core-Loss Ampere-Turns $i_c S_1$.

In general:

Total core-loss in watts $= W = e_1 i_c$,

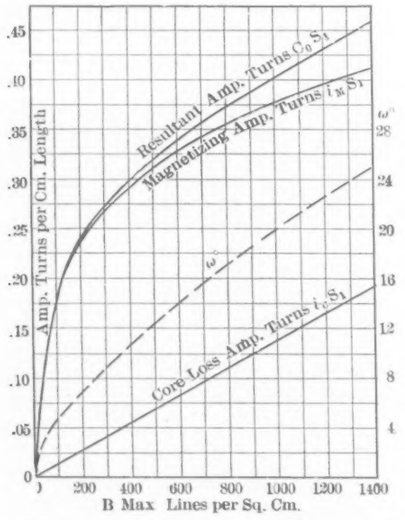

Amp. Turns per Cm. Length
Resultant Amp. Turns $C_0 S_1$
Magnetizing Amp. Turns $i_M S_1$
Core Loss Amp. Turns $i_c S_1$
ω
B Max Lines per Sq. Cm.

Fig. 4—Magnetomotive Forces Required for Excitation.

and,

$$e_1 = 4.44 \times 10^{-8} S_1 f B_m A,$$

where,

f = frequency.

A = cross-section of core in square centimeters.

Therefore,

$$W = 4.44 \times 10^{-8} f A B_m (S_1 i_c).$$

If 1 cm length of the core be considered, then $i_c S_1$ in the above equation will be the root-mean-square ampere-turns per centimeter, and denoting these by b there is obtained,

$$\text{Watts per pound} = w = \frac{W}{A\delta} = 4.44 \times 10^{-8} \frac{fB_m}{\delta} b$$

where,

δ = specific gravity of iron in pounds per cubic centimeter.

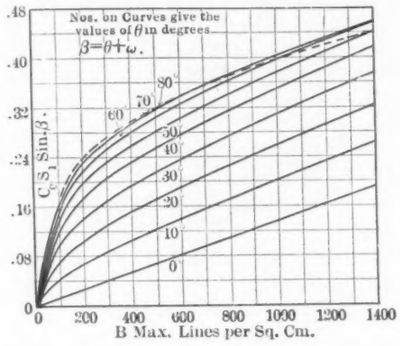


Fig. 5—Variation of Exciting Current with Magnetic Density.

Therefore,

$$b = \frac{w\delta}{4.44 \times 10^{-8} f B_m} \quad (8)$$

This equation is quite general in its application.

Fig. 3 shows the core-loss curve for "stalloy" iron corresponding to the low values of B_m. This curve was obtained experimentally; it obeys a very definite law, being, in fact, a parabola. The equation is as follows:

$$w = 1.78 \times 10^{-5} B_m^2.$$

This equation is only true for fifty cycles, the core-loss test being carried out at this frequency. As, however, only a very small percentage of the total loss—probably not more than 5 per cent—is due to eddy currents, it can safely be assumed that the total loss is directly proportional to the frequency, so that, in general,

$$w = 3.56 \times 10^{-10} f B_m^2$$

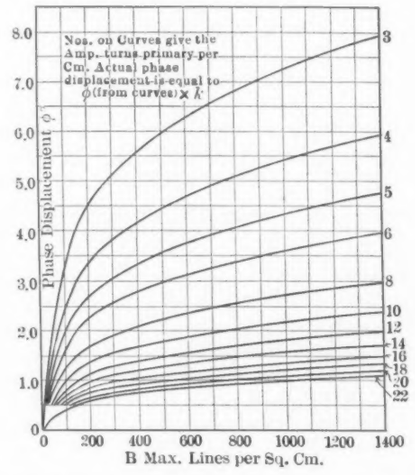

Nos. on Curves give the Amp. turns primary per Cm. Actual phase displacement is equal to ϕ (from curves) x k
Phase Displacement ϕ
B Max. Lines per Sq. Cm.

Fig. 6—Phase Displacements for Low-Current Values.

Also, for stalloy iron

$$\delta = 0.0173.$$

Substituting these values of w and δ in equation (8)

$$b = 1.385 \times 10^{-4} B_m \quad (9)$$

This equation shows that the core-loss ampere-turns per centimeter length of magnetic circuit are directly proportional to B_m and independent of the frequency.

Resultant of Magnetizing and Core-Loss Ampere-Turns (C_0S_1).

In general:

$$C_0S_1 \text{ per centimeter} = \sqrt{a^2 + b^2} \qquad (10)$$

(a) Values of B_m Between 0 and 150.

Between these limits of B_m, b is so small in comparison with a that it is near enough to assume that:

$$C_0S_1 \text{ per centimeter} = a,$$

the error so caused being not greater than 0.5 per cent.

(b) Values of B_m Between 150 and 1400.

Substituting the values of a and b as given in equations 7 and 9 respectively, in equation 10 there is obtained a general equation giving C_0S_1 per centimeter in terms of B_m, which is as follows:

$$C_0S_1 \text{ per centimeter} = a\sqrt{1 + (6.45 \times 10^{-6})\, B_m^{1.44}} \qquad (11)$$

Angle ω.

Fig. 1 shows clearly that in general:

$$\tan \omega = \frac{b}{a}$$

One can, therefore, deduce two equations as follows:

(a) Values of B_m Between 0 and 150.

$$\tan \omega = 0.0141\, B_m^{0.38} \qquad (12)$$

(b) Values of B_m Between 150 and 1400.

$$\tan \omega = 0.00254\, B_m^{0.72} \qquad (13)$$

The equations deduced above for the four quantities, namely, i_mS_1, i_cS_1, C_0S_1 per centimeter and angle ω, have been plotted in Fig. 4, from which the value of either of these quantities corresponding to a known value of B_m can be at once determined.

DETERMINATION OF CURRENT-RATIO K_a.

The fundamental equation given in equation (1) is:

$$K_a = \frac{C_1S_1K}{C_1S_1 - C_0S_1 \sin \beta} \quad \text{where } \beta = \theta + \omega$$

That is, as the secondary load becomes more inductive θ will, of course, increase in value, and, other things being the same, the above equation shows that the current ratio will also increase and differ more widely from the theoretical ratio of K. One would, therefore, expect that the ratio characteristic with a non-inductive secondary load is much better than that obtained with an inductive load, and this is actually found to be the case. From this standpoint it is advisable to make θ as small as possible, although, as will be shown later, this will make the phase-displacement characteristic much worse.

The function $C_0S_1 \sin \beta$ is plotted in Fig. 5 against B_m for different values of θ, so that by aid of these curves it is quite an easy matter to construct ratio curves corresponding to given load conditions, provided that the number of primary turns, secondary turns and mean length of magnetic circuit are known. Conversely, the curves can be used for designing purposes, and the primary ampere-turns at full load required to give a ratio error within certain limits at a specified load determined, if the resistance and inductance of the secondary load are known.

It is quite obvious that before the curves can be used to calculate the value of K_a for any particular load the values of B_m and θ corresponding must be known. This question will be dealt with later, and, to make the method of procedure quite clear, an example will be given showing the ratio characteristics of an actual transformer as determined by this method.

DETERMINATION OF PHASE DISPLACEMENT.

The phase displacement between the primary and secondary currents is of extreme importance in cases where either an indicating or recording wattmeter or watt-hour meter is operated from the secondary of a series transformer; in fact, in all cases where the instrument so operated has both series and shunt windings.

Referring to the fundamental equation (2), given above it is seen that:

$$\phi = 57.4 \frac{C_0S_1}{C_1S_1} \cos(\omega + \theta) \text{ deg.}$$

If it be assumed that θ = zero—that is, that the secondary load is perfectly non-inductive—then it is quite clear that ϕ is dependent only on C_0S_1 per centimeter and ω for a given value of the primary ampere-turns (C_1S_1) per centimeter. One is therefore able to plot a number of curves connecting ϕ and B_m, assuming a definite value for C_1S_1 per centimeter in each case.

This has been done and the curves shown in Figs. 6 and 7 cover a range of primary ampere-turns per centimeter from 3 to 100. In a well-designed transformer the values of C_1S_1 per centimeter for loads ranging between full load and one-tenth load will be within these limits, so the curves as plotted should meet the majority of cases likely to arise in practice in this respect.

An absolutely non-inductive secondary load is, of course, never obtained in actual practice, and an inspection of the fundamental equation previously referred to will make it clear that if any value of ϕ as obtained from the curves be multiplied by a constant

$$k = \frac{\cos(\omega + \theta)}{\cos \omega}$$

the result will be the correct value of ϕ corresponding to the particular value of θ used in this expression.

To facilitate matters a number of curves have been plotted giving the value of k in relation to B_m, for various values of θ ranging between zero and 90 deg. These are shown in Fig. 8, and it will be at once observed that as θ is increased the constant k, and therefore ϕ, decreases. It is also interesting to note that some of the curves cross the zero line, and for certain values of θ the constant k is negative. This means that in such cases ϕ will also be negative, the physical meaning being that the phase displacement between primary and secondary currents can be made greater than 180 deg. if θ be large enough, and the secondary current instead of relatively *leading* the primary current in phase will *lag* behind it. Corresponding to the value of k = zero, ϕ will be zero and the secondary current will be exactly opposite in phase to the primary current. This happens when $(\omega + \theta) = \beta = 90$ deg., and a reference to Fig. 1 will make this clear, because then KC_2S_1 will be in phase with C_0S_1, and C_1S_1, and the primary ampere-turns will be simply equal to the secondary ampere-turns + C_0S_1.

By aid of the curves given in Figs. 6, 7 and 8 one can quite easily construct phase-displacement curves showing how ϕ varies with the load. As in the case of ratio curves, it must be assumed that the value of B_m is directly proportional to the primary current, and before referring to the fundamental curves the value of B_m at full load must be known. It is also necessary to know the value of θ. The method of calculating these two quantities will now be dealt with.

DETERMINATION OF B_m AND θ.

Taking a typical case, assume that the secondary load consists of an ammeter, wattmeter and trip coil connected in series. Suppose that resistance of ammeter = r_1; reactance of ammeter = pl_1; resistance of wattmeter = r_2; reactance of wattmeter = pl_2; resistance of trip coil = r_3; reactance of trip coil = pl_3, where $p = 2\pi f$, f being the frequency.

Fig. 9 gives a vectorial representation of the secondary load, from which it is clear that the induced secondary voltage e_2 is the resultant of three components, and

$$e_2 = C_2 \frac{(R_3 + R_2)}{\cos \theta} \qquad (14)$$

where

R_2 = resistance of secondary

$R_3 = r_1 + r_2 + r_3$

Calling

$$L_3 = l_1 + l_2 + l_3$$

there is obtained

$$\tan\theta = \frac{pL_2}{R_2 + R_2} \qquad (15)$$

These two equations enable one to calculate θ and e_2 pro-

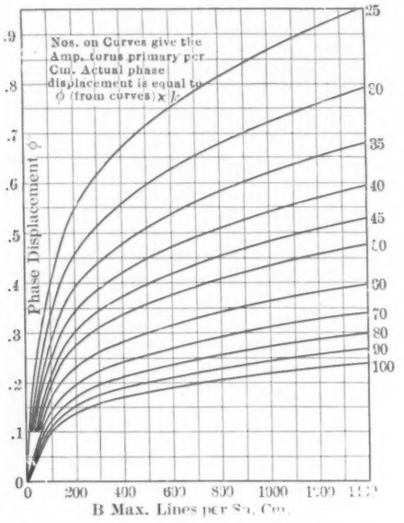

Nos. on Curves give the Amp. torus primary per Cm. Actual phase displacement is equal to ϕ (from curves) x I₂
Phase Displacement ϕ
B Max. Lines per Sq. Cm.

Fig. 7—Phase Displacement Between Primary and Secondary Currents for Large Current Values.

vided the resistance and self-induction of each component part of the secondary load are known.

Further,

$$e_2 = \frac{4.44}{10^8} S_2 A f B_m$$

where

A = cross-section of core in square centimeters.

Therefore,

$$B_m = 2.25 \times 10^7 \frac{e_2}{S_2 A f} \qquad (16)$$

Substituting in this equation the value of e_2 as given in equation (14) there is obtained as a final result:

$$B_m = 2.25 \times 10^7 \frac{(R_2 + R_2)}{S_2 A f \cos\theta} C_2 \qquad (17)$$

Equation (16) or (17) enables one to calculate B_m for given values of the secondary turns, cross-section of core and frequency. The first equation is used in cases where

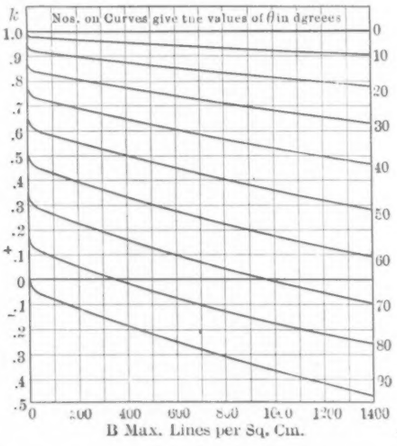


Fig. 8—Ratios of Cosines of Time-Phase Angles for Various Secondary-Phase Displacements.

the voltage drop in the secondary is known, and values for the second equation are taken directly from the total resistance and inductance of the secondary load. Taken in conjunction with equation (15), equations (16) and (17) show that the effect of increasing the secondary load resistance R_2 is to *increase* the value of B_m and *decrease* the value of θ for given conditions. On the other hand, increasing the secondary inductance L_2 will also cause an *increase* in the value of B_m, but at the same time an *increase* in the value of θ. The effect on the ratio and phase displacement characteristics of varying the secondary resistance and inductance can easily be determined by considering the curves given in Figs. 5, 6, 7 and 8.

As the values of B_m and θ for given load conditions are dependent on the frequency on which the transformer is operating, it is apparent that the characteristics of any

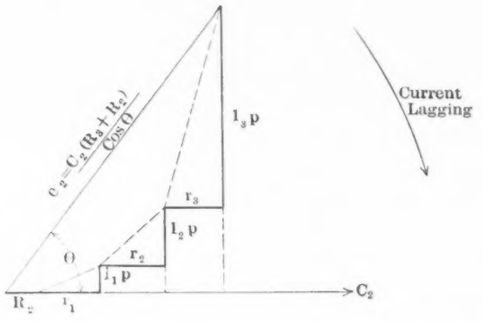


Fig. 9—Vector Representation of Secondary Load.

transformer will be affected by variations in the frequency. This particular point will be considered in a later issue.

THE ELECTRIC IRON-REDUCTION PLANT AT TROLLHÄTTAN, SWEDEN.

Experiments on a Large Scale for Determining the Commercial Possibility of Electric Iron Reduction.

At a recent meeting of the Swedish Association of Iron Masters (Järnkontoret) at Stockholm a report was submitted regarding the electric furnace of Trollhättan. As previously mentioned in the *Electrical World*, the association appropriated in October, 1909, a sum of $69,000 for the erection of a test furnace of the Grönwall, Lindblad and Stalhane type, which furnace should be of such dimensions that it could be worked as a commercial enterprise and its practicability as such be ascertained. The association received the co-operation of the government in the way of a free site on the government's grounds at Trollhättan and electrical energy at nominal cost from the government's power station. A 700-hp furnace of the same type has been in operation at Domnarfoet, Sweden, since the autumn of 1908, and in designing the new furnace the inventors could to a large extent profit from the experiences with the smaller furnace at Domnarfoet.

Besides the investigating of the larger furnace as a commercial possibility a number of points regarding the design and the behavior of the furnace were to be investigated, the most important of which were the following: The proper height of the furnace and other dimensions most suitable for different purposes and different charges; the most suitable design and way of building; consumption of electrodes and the shape and arrangement of electrodes; energy consumption per ton of iron of certain composition; coal consumption per ton of iron of certain composition; circulation of gas, its significance for the economy and means to accomplish circulation in case of choking charges; manufacturing of iron of different composition; conduct of various charges and concentrates and

the influence of same on the economy; value of escaping gases; efficiency of the furnace; maintenance cost at the furnace.

On Nov. 29, 1909, the work of excavating was commenced, and on Nov. 15, 1910, the furnace was started. Consignments of ore were sent from the different mines in

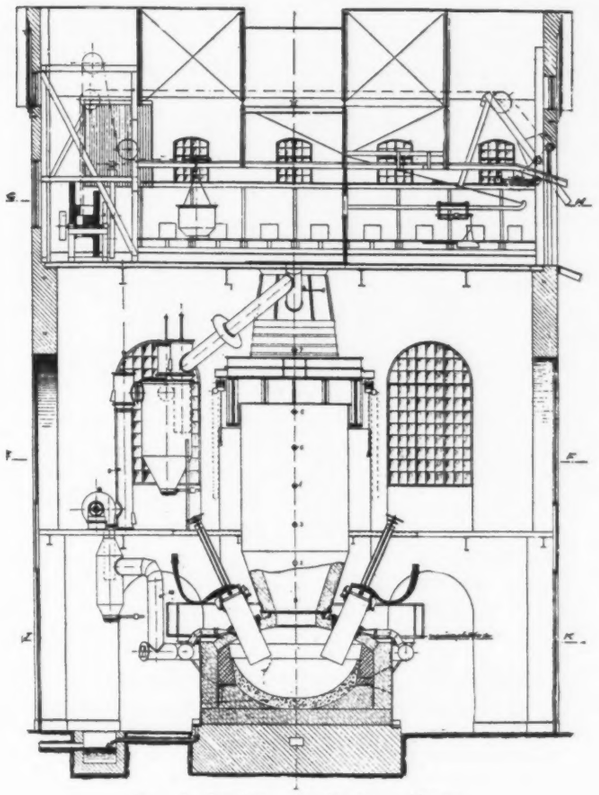


Fig. 1—Section of Furnace House.

Sweden to be smelted, and the pig-iron produced was sent to Swedish steel works to be made into steel, the quality of which was then tested.

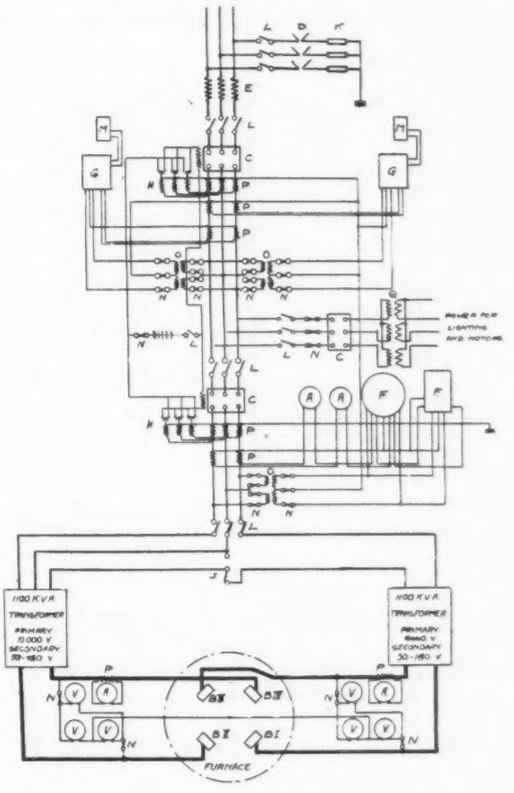
The plant comprises the following buildings: Coal storage, crusher building, furnace house and office building. The coal storage can hold a six months' supply of charcoal, or about 7000 cu. m. The coal is carried on band conveyors from the cars to the storage and from there by means of iron buckets running on a wire rope to the furnace top. The ore is taken from the heaps outside the crusher building by an elevator truck up to an incline, along which it slides into the crusher. The crushed material falls into a sheet-iron hopper, in which a sufficient quantity is collected to fill the truck to be elevated to the furnace top. The limestone, which is used as a flux, is crushed and transported in the same way.

The construction of the furnace is shown in Fig. 1. It is built in two separate parts, the shaft and the crucible or hearth. The shaft is a steel shell lined with firebrick. At the top it is riveted to an octagonal channel-iron ring, which rests on two beams supported by the walls of the building. At the top of the shaft is a Tholander charging bell operated by a 2½-hp reversible, three-phase motor. This bell is designed to deliver the ore round the sides and the charcoal at the center of the shaft. The hearth rests on a concrete foundation. The cover is made of 15-mm riveted steel plates, on the upper side strengthened by a 200-mm by 18-mm iron band. It is lined with firebrick with an inner lining of magnesite brick, the bowl-shaped bottom and the sides being rammed by a mixture of magnesite and tar. The electrodes are inserted through the roof at an angle 65 deg. to the horizontal. Each electrode consists of four square carbons having an area of 660 mm by 660 mm. At the opening in the roof each electrode is surrounded by a copper water-jacket, provided with an asbestos packing to prevent leakage of gas. The electrical contact pieces are wedged between the upper end of the electrodes and a holder of cast steel. This frame can be raised or lowered between two guides one on either side of the electrode.

The circulation of gas in this furnace is particularly important. The gas is drawn from the cool upper part of the shaft and blown into the crucible immediately under the hot roof. In this way it serves the double purpose of cooling the roof of the crucible and thus prolonging its life and on its way up through the shaft heating the charge and thus helping to a certain extent the reduction.

THE ELECTRICAL EQUIPMENT.

Three-phase alternating current is delivered at 25 cycles and 10,000 volts from the government power station. The feeders are provided with single-horn lightning arresters with series-coupled oil resistances and with inductance coils. The main switch has automatic circuit-breakers. The relays of Siemens type are adjustable for time as well as for overload and are actuated by means of dry batteries. After passing various series instrument transformers and



A—Ammeters.
B—Electrodes.
C—Automatic Oil Switches.
D—Lightning Arrester.
E—Induction Coil.
F—Wattmeters.
G—Kilowatt-hour Meters.
H—Maximum Relays.
J—Switch.
K—Oil Resistance.
L—Main Switches.
M—Clock Control.
N—Fuses.
O—Transformers.
P—Transformers.
Q—Transformers.
V—Voltmeters.

Fig. 2—Diagram of Connections.

another oil switch the mains enter the furnace transformers.

The two furnace transformers are each of 1100 kva, with a guaranteed overload capacity of up to 1375 kva under one hour. They are T-coupled, giving secondary two-phase currents. Regulation is possible between 50 volts and 90 volts in eight stages and by different connections of

the secondary coils also from 100 volts to 180 volts. The voltage can be regulated during operation.

The transformers, which are oil-insulated and water-cooled, are installed each in a separate chamber in the furnace-room. To make operation possible with only one transformer the high-tension side has been provided with a switch by means of which any one of the transformers can be coupled to the mains.

The low-tension conductors from the transformers are taken through the wall into the furnace-room. These conductors consist of six copper bars, 8 mm by 200 mm, for each electrode. These bars are supported on insulated clamps of brass. The energy is conducted to the four electrodes through 192 flexible cables (forty-eight per electrode). Each cable has an area of 185 sq. mm.

The instruments required for observing and regulating the working of the furnace and the electrodes are placed on an instrument board on the working floor. In the so-called furnace office on the floor above are placed the wattmeters showing the power consumption for the furnace and two kw-hour meters. In the same room are placed two galvanometers for the eight thermoelectric pyrometers, which measure the temperature in the furnace.

In electric pyrometers platinum-platinum-rhodium elements and silver-constant elements are used, the former in the lower and the latter in the upper part of the furnace. They are arranged to record the temperature every ten minutes.

ELECTRODES AND ELECTRODE CONSUMPTION.

Part of the electrodes used at the works were supplied by the Planiawerke, Ratibor, Silesia, and part by the Höganäs-Billesholm Company, Sweden. The purpose in using both was to obtain a comparison between the well-known Planiawerke electrodes and electrodes of Swedish manufacture. Results of the analyses of the electrodes are shown in Table I.

TABLE I.—ANALYSIS OF ELECTRODES.

	Electrodes from	
	Plania.	Höganäs.
	Per Cent	Per Cent
Ash	0.79	3.96
S (total)	2.80	1.06
P	0.27	0.16
Composition of the Ash:		
SO_3	0.44	0.97
P_2O_5	0.627	0.37
SiO_2	37.80	42.00
K_2O+Na_2O	1.21	0.45
CaO	6.08	10.20
MgO	2.62	2.16
Fe_2O_3	28.04	21.70
Mn_3O_4	0.52	0.38
Al_2O_3	21.22	19.80
Total	98.557	98.03

The rather large difference in the ash analyses is probably due to the difficulty in consuming the last traces of carbon by ignition.

From the above will be seen that the Höganäs electrodes contain a somewhat high percentage of ash and sulphur. In producing iron of high quality it is, of course, necessary that especially the percentage of sulphur should be kept as low as possible. With the electrode consumption found in actual operation and assuming that all of the sulphur combines with the iron, 1 per cent sulphur in the electrodes corresponds to 0.005 per cent to 0.006 per cent sulphur in the iron.

The electrodes in the furnace are four in number. Each electrode is built up of four carbons, 2 m long and 330 x 330 mm in cross-section arranged to form an electrode of 660 x 660 mm cross-section. Before being bound together the sides forming the joints are planed to a flat surface and the joint is made with a thick paste of molasses and graphite, so that the closest joint possible is formed. The upper part of the electrode is covered with asbestos paper and thin sheet iron, and the top surface is covered with a thick layer of ground asbestos and silicate of potash.

The sides of the electrodes are carefully planed smooth at the upper part for a distance of about 250 mm in order to make a good contact surface for the electric contacts. Between these and the electrode is also placed a fine-mesh copper wire cloth.

In order to observe the quality of the different makes, electrodes were built up of carbons from the two factories and each kind was used under similar conditions. No difference in durability could be discovered.

Table II gives the complete record for two electrodes (called No. 1 and No. 2), also the average for ten electrodes.

TABLE II.—RECORDS FOR ELECTRODES.

Electrode.	Working Time.		Weight in Kg.		Consumption of Electrode.		Consumption per Ton of Iron.	
	Hours.	Min.	Before.	After.	Total Kg.	Per Cent.	Gross.	Net.
No. 1	1041	37	1321	557.5	763.5	57.79	2.09	1.21
No. 2	1115	31	1325	743	582	43.92	1.85	0.81
Average of 10	906	6	1313.3	635.8	677.5	51.61	2.28	1.16

An average of 110 liters per minute of cooling water was used for cooling the electrodes with a loss of an average of 97.8 kw, which is nearly 7 per cent of the total load on the furnace.

THE CHARGES.

During the time which this report concerns twenty-nine different qualities of charge were used, which, however, may be regarded as four main groups, viz., unroasted Tuollavaara, roasted Tuollavaara, Borgvik and Uddeholm ores.

The table forms a summary report of the energy and electrodes used for respective charges and also the amounts of pig iron and slag produced from four groups of charges.

Analyses of the iron were made from each tapping and analyses of the slag and the gas at frequent intervals. The tables are of great interest as showing the continuous and regular working of the furnace, but are too extensive to publish in these columns.

WORKING RESULTS.

While it may not be advisable to draw final conclusions on the basis of the results obtained, it is nevertheless of interest to examine these results with a view to find indications for the continued development and improvement of the process.

As a definite and highly satisfactory experience it should be noted that the need of repairs to the crucible has been very slight. During a period of nearly five months of continuous working only about eighteen hours have been required for repairs, which must be regarded as an eminently satisfactory result.

It is also satisfactory to note that the height and other dimensions of the shaft have in the main proved correct for normal conditions for fuel and ore.

If, however, earthy ore or concentrates or too fine fuel be used, or if the charge contains too much moisture, the working is injuriously affected, as would equally be the case with an ordinary blast furnace, and the design of the shaft does not appear to be well suited for such conditions. This is because it is then especially important to maintain a strong circulation of gas.

If this cannot be done the moisture is not evaporated, but gradually penetrates further down in the shaft, causing a lowering of the temperature. The reducing power of the CO is then decreased and the percentage of CO_2 in the resulting gas decreases. But this percentage of CO_2 is the indicator of the degree of utilization of the fuel used and must, therefore, under all circumstances be maintained as high as possible.

For the conditions mentioned a shaft with a wider neck would be more suitable, as it leaves a larger space for the gas to pass up and a reduction of the temperature would be counteracted. Possibly it would also be an advantage to make the shaft wider and lower.

In order to produce an effective and uniform circulation of the gas it is in the first place necessary to purify it by washing, so that the frequent interruptions for cleaning may be avoided. Further, the gas pipes must be quite tight so that the gas drawn by the fan is really blown into the crucible, which must also be made as tight as possible. Alterations in these respects have recently been made.

The circulation of gas, which is so useful and necessary for the purpose indicated above, and which, moreover, is a protection for the roof, has, however, the disadvantage that the electrodes are attacked by the carbonic acid in the gas. Nevertheless, the electrode consumption has been low. The average for the entire time per ton of iron has been 10.28 kg gross and 5.27 kg net. Electrodes with screw joints are now being adapted for the furnace and the gross consumption may then be reduced—under most favorable circumstances to equal the net consumption.

The experience with this furnace appears to indicate that with this size four electrodes is a minimum number. It would probably be better to use six electrodes with three-phase currents. This would distribute the heat more uniformly and the risk of disturbances of the work on account of defects in the transformers would be reduced. Losses through cooling water would in this case probably be increased, but this would undoubtedly be more than counterbalanced by the advantages gained.

During the time to which the report refers only unburnt limestone has been used. In view of future comparisons with ordinary blast-furnace results it was desired to maintain the conditions very similar to those under which the same ores are usually treated. It is, however, evident that by the use of burnt lime the economy of the process will be improved and this improvement would increase in proportion as the quantity of lime required is increased. Whether unburnt or burnt limestone is used the percentage of CO_2 in the gas remains the same. This proves that the CO_2 derived from the limestone may be replaced by CO_2 formed by the reduction of the ore by CO. The energy required for burning the limestone is, therefore, saved and the same quantity of fuel reduces more ore.

At the end of the test period in the early part of June the furnace was shut down for the purpose of making the alterations mentioned above. It was again started during the first week of September and has since been in uninterrupted work.

Comparing the figures in Table IV with the earlier results it will be seen that a great improvement has been obtained over the first six months' working result.

TABLE III.—SUMMARY REPORT OF TESTS.

Per Cent Iron in		Slag per Ton Iron.	Material Charged per 100 Liters Charcoal.	ELECTRIC POWER.									CONSUMPTION OF ELECTRODES.			
				Time Used.						Kw-hours Used.		Iron Produced per Kw-year.	Gross.	Net.	Per Ton Iron.	
				For Working.		For Interruptions.		Total.		Average Load.	Total.	Per Ton Iron.			Gross.	Net.
Ore.	Charge.	Kg.		Hours.	Min.	Hours.	Min.	Hours.	Min.	Kw.			Ton.	Kg.			
Group I																
Total 65.57	62.10	205	66.49	2,009	56	105	39	2,115	35	1,319	2,651,029	2,296	3.82	13,012	6,743	11.24	5.83
Group II																
Total 65.06	62.56	224	71.13	184	32	4	58	189	30	1,694	312,601	2,149	4.08	1,578	763	10.84	5.24
Group III																
Total 49.50	42.42	780	90.31	639	18	20	57	660	15	1,017	650,480	2,623	3.34	2,281	1,121	9.19	4.52
Group IV																
Total 57.92	53.06	458	69.88	506	34	22	11	528	45	1,733	877,706	2,643	3.31	2,474	1,285	7.45	3.87
Grand Total 61.54	57.00	327	70.77	3,348	10	153	45	3,501	55	1,344	4,500,596	2,391	3.66	19,345	9,912	10.28	*5.27

*Net—51.24% of gross.

Per ton of iron there were then used from 2150 to 3800 kw-hours, and for the entire time an average of 2391 kw-hours. The ores then used varied somewhat in quality, but it will be seen that a reduction of 20 to 25 per cent has been effected in the energy consumption. Correspondingly, the output of pig-iron per kw-year has been raised from an average of 3.66 tons to over 5 tons. The charcoal consumption has been reduced from 418 kg to from 340 kg to 345 kg per ton of iron, and the electrode consumption has also been reduced. The electrodes now used are supplied by the Planiawerke, and are provided with screw joints so that there are no waste stumps.

The practical importance of the process is best proved by the fact that there are now built or building furnaces for an aggregate of 27,000 hp, while, in addition, furnaces for about 36,000 hp are projected.

TABLE IV.—WORKING RESULTS FOR THE PERIOD SEPT. 3 TO SEPT. 30.

Pig-iron produced, tons	537.9
Quantity of slag, tons	88.9
Iron in the ore, per cent	67.65
Iron in the ore and lime, per cent	65.02
Quantity of slag per ton of iron, kg	165
Charcoal used per ton of iron, kg	339.9
Average load, kilowatts	1,407
Average power, horse-power	1,913.5
*Energy used per ton of iron, kw-hours	1,749
†Iron produced per kw-year, tons	5.01
Iron produced per hp-year, tons	3.68
Average CO_2 contents in gas, per cent	29.27
Average analysis of iron:	
C, per cent	3.64
Si, per cent	0.36
Mn, per cent	0.40
S, per cent	0.009
P, per cent	0.018

*According to instruments at the furnace.
†Estimated on the basis of 8,760 kw-hours per kw-year.

MANAGEMENT OF THE WORKS.

The management of the plant is in the hands of a committee appointed by the association and consists of Major-

General G. Geijer, Mr. Aug. Herlenius, chamberlain to the King, and Messrs. J. A. Brinell, chief engineer of "Järnkontoret," Axel Wahlberg and E. Odelberg, the last named acting as managing director for the committee.

At the works the management has been in the hands of Messrs. J. A. Leffler and E. Nyström, both engineers on the staff of "Järnkontoret," the former acting as general manager and the latter as superintendent.

The employees at the furnace consist of three men for charging, two for bringing up charcoal, four for crushing and bringing up ore, five furnacemen, three men for fitting electrodes, two for weighing iron and slag, one blacksmith, one blacksmith's helper, one electrician, five men for loading and unloading, one carpenter and one watchman and messenger, making a total of only twenty-nine workmen employed in the various operations.

Central Station
Management, Policies and Commercial Methods

GUESSING CONTESTS IN CHICAGO.

This year the employees of the Commonwealth Edison Company of Chicago have established two guessing contests, one based on the maximum load of 1911 before Dec. 22, in kilowatts, and the other on the largest day's kilowatt-hour output. The pools are kept separate, and each is to be divided 60 per cent to the one guessing nearest the correct figure and 40 per cent to the one guessing next nearest. The fee is 25 cents for each guess, and not more than five guesses are permitted in each pool from one person. Both pools will be divided on Saturday morning, Dec. 23. No guesses were received after Nov. 29. The highest total maximum output of the company to date occurred on Nov. 1, 1911, and was 190,160 kw. The largest kilowatt-hour output in one day up to the present time occurred on Nov. 2, 1911, and was 2,392,200 kw-hours.

FOLLOWING DOWN THE COMPLAINTS.

Most central stations are "up against" the difficulty that their customers' complaints receive only a perfunctory examination and reply, without having the trouble traced all the way back to its cause to guard against repetition of the objection. After an experience with dividing the responsibility for complaints among the various members of its office staff, one large central-station company is now arranging to put all complaints in the hands of one man, who has instructions to investigate each case to the very bottom. He will, of course, have the assistance of department heads in furthering his inquiries, but is expected to see each case through to the end. As the complaints are disposed of all the data connected with each case will be filed under a separate classification, and if repeated complaints are then received from the same customer, his status either as a chronic "kicker" or the subject of real and uncorrected injustice can be readily ascertained.

KEEPING THE ISOLATED PLANT OUT OF BROOKLYN.

The Edison Electric Illuminating Company of Brooklyn has ever been mindful of the great advantage to be derived from a good motor load, and in its strenuous endeavors for a brighter Brooklyn has managed to carry on some excellent work among manufacturers and contractors, thereby improving the load-factor of its system and adding to its revenues, a not altogether unwelcome combination. During the sixty days ended Nov. 1 the sales department has closed contracts for more business than was ever written in a similar period in the history of the company. The energy consumption will aggregate over 10,000,000 kw-hours per annum on these contracts alone, and it is of interest to note that the business was snatched from the isolated-plant field.

Five of the contracts are of more than passing interest and size, and the sales department of the Brooklyn company takes commendable pride in transmitting the details. The Tidewater Paper Mills, a new concern which will manufacture paper from pulp brought from Canada, will operate entirely by electricity. The connected load is 1000 hp and the load-factor over 60 per cent. The estimated revenue from this contract will exceed $50,000 per annum.

A contract with the Bush Terminal Company has been closed for a long term of years covering the supply of electricity for existing loft buildings and three in course of erection. The connected load approximates 4000 hp and the estimated annual income $100,000. Another terminal company supplied with energy is the New York Dock Company, whose two private plants were shut down and replaced by Edison service a short time ago. This company has now contracted for a further supply for two additional loft buildings which will pull about 1500 hp from the Edison company's system. The annual revenue received from the dock company is estimated at $25,000.

The Sternau Company, manufacturer of the famous Sternau ware, has signed a contract covering the complete needs of its new building on John Street. The company has at present in its old building an isolated plant which will be dispensed with. The annual revenue which this contract will add to the receipts of the company is estimated at $10,000. Still another isolated plant will give place to central-station service. The works of the Thomas Gill Soap Company, which were formerly operated by steam-driven apparatus, will hereafter take energy from the mains of the Brooklyn Edison company. The total business secured during the month of October exceeded that of the same period a year ago by 40 per cent.

APPLICATION OF ELECTRIC HEATING TO CELLULOID INDUSTRY.

In the manufacture of small articles of celluloid electric heating finds an application where practically no other heat source offers competition. Celluloid, as is generally known, is made from guncotton, camphor, etc., subjected to hydraulic pressure, and shares the highly inflammable nature of its principal constituent. For this reason it is important that flame of any kind be kept out of celluloid factories and workrooms, so that high-pressure steam has usually been used for heating the material during forming. Celluloid softens at about 250 deg. Fahr., but ignites at about 280 deg., so that the closest temperature control is required in handling it.

Use is being made of electric heating in Chicago in the establishment of a number of such small celluloid article factories in loft and factory buildings and other places formerly impossible for this purpose on account of absence of high-pressure steam. One operator of a small celluloid-comb factory in Chicago recently moved to a new location where steam was not available, and found that the owners

of the building would not permit the installation of a gas-heated high-pressure boiler. Finally he applied to the Commonwealth Edison Company, whose lines reached his new factory, and was shown how he might use an electric hot-plate element, which has since been in service with much satisfaction.

Since then one of the large manufacturers has developed a special celluloid heating element measuring 18 in. by 30 in. The running consumption is 225 watt-hours per hour, while for quick starting 450-watt and 900-watt connections are provided which quickly bring the surface of the plate up to the proper temperature. The heat is so adjusted that the celluloid blanks for combs or other articles can be laid on the plate in succession, the first one being properly softened by the time the last has been laid down. In this way the operator works continuously without loss of time. The new application of electric heat to the manufacture of celluloid articles is expected to make possible the establishment and operation of many such small factories in districts and cities where the requirements of special steam heat formerly made this impossible.

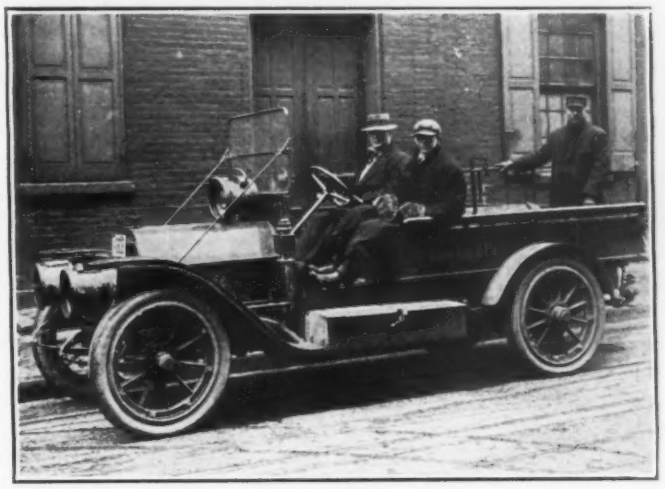
N. E. L. A. COMPANY SUGGESTION AND QUESTION BOXES.

Throughout the offices and departments of The Milwaukee Electric Railway & Light Company the local N. E. L. A. section has installed panels carrying letter boxes and racks of printed forms and envelopes for suggestions and questions pertaining to central-station matters. The question blank used, printed on white paper, has space for the query on one side and the answer on the reverse. The suggestion forms are printed on colored paper, one side bearing the conditions of the suggestion-box contest, which includes the award of $15, $10 and $5 in cash prizes for the best offerings during the year. All questions and suggestions are to be inclosed in the envelopes provided and dropped into the letter boxes. Mr. C. M. Wheelock is chairman of the question-box committee, and Mr. C. N. Duffy is chairman of the suggestion-box committee. Mr. O. M. Rau is president of the local section, Mr. A. H. Sikes vice-president, Mr. G. G. Post secretary, and Mr. F. J. Boehm treasurer.

CINCINNATI'S 60-HP EMERGENCY LINE AUTOMOBILE

Mr. F. R. Healey, superintendent of distribution for the Union Gas & Electric Company of Cincinnati, has just placed in service a completely equipped new emergency automobile which is used for making hurried runs in cases of overhead or underground trouble. The new wagon was especially designed and built to meet the needs of the line department and makes use of the chassis of a 60-hp Stearns touring car. Fully loaded with crew and a transformer or two, it is capable of running up any of the severely steep grades among the hills of Cincinnati at a speed of 30 miles an hour, or faster if desired on the level stretches. For illuminating the tops of poles or lines where repair men are doing emergency work after dark the car is equipped with powerful acetylene search-lanterns. The regular sidelamps are supplied from a storage battery carried on the machine, and are inclosed in red glass like the local fire-department wagons, demanding right-of-way over all other traffic. In boxes at the sides of the body is carried a full equipment of tools for doing overhead and underground work.

The truck is kept at the company headquarters on Plum Street, where a driver is always available. When a hurry call is received the wagon is immediately dispatched to the nearest place where the regular line crews are working and enough men are picked up to handle the emergency job, to which the car is next hurried. If it develops that a transformer or some other piece of equipment is required to complete the emergency repair the car can be sent to the storeroom for it without loss of time, returning while the repair gang is making ready. Using the wagon as a tractor, such a transformer can be hoisted to the pole-top



60-hp Emergency Line Automobile.

quickly and with little manual effort. In the case of emergency calls after night the car is first sent out to rouse such men as cannot be reached by telephone and then makes a second round picking up its crew from their respective homes. The Cincinnati company formerly had in service a lighter automobile which was used for a similar purpose, and this machine proved so valuable that the present powerful car was purchased and equipped.

ELECTRIC FANS FOR SCHOOLHOUSES.

Dr. W. A. Evans, formerly commissioner of health for the city of Chicago, now conducts a valuable department in the Chicago *Daily Tribune* under the heading "How to Keep Well." In a recent issue he discussed the subject of school ventilation, and among the recommendations he made was one of particular interest to those engaged in the selling of electric fans and of electricity to operate them. Dr. Evans' suggestions apply to schools in towns and cities in the United States located north of the latitude of Memphis, Tenn., and east of the longitude of, say, Phœnix, Ariz.

The Chicago Ventilation Commission has indorsed the following propositions: (1) In a mixture of air containing carbolic acid this gas does not settle out and rest near the floor. (2) The dilution method of ventilation is ineffective and uneconomical. (3) The putting of a given volume of air into a room does not necessarily constitute ventilation. (4) Ventilation is done better by air currents than by dilution. In practice, however, these principles are not observed, and the former health commissioner points out that almost invariably the air in schoolrooms is too still.

Authorities on the subject seem to have proved that air cannot be regarded as healthful unless it is moving with a considerable degree of velocity. As it strikes the body it must have force enough to blow away the foul air, and it must clean the breathing zone, which is the air around the head. Furthermore, it must clean the air around the body and under the clothing, which is referred to as Sedgwick's "aerial envelope." Therefore, still air may be regarded as deadly. Present methods too often result in giv-

ing the air in schoolrooms a morgue-like stillness. The hot air, frequently of a temperature about 130 deg. Fahr., is introduced about 8 ft. above the floor. Theoretically this air blows across the room against the ceiling, diffuses through the air, and leaves gently by an exit near the floor line. The object is to do away with air currents.

In practice this system of indirect ventilation does not give satisfactory results, and it is particularly to be deplored in schoolhouses, where the health of young children may be affected. The suggestion which is made by Dr. Evans is that schoolrooms be equipped with electric fans to be operated during the winter when the windows are closed or nearly closed. The author observes that fans are a means of comfort during the summer, but they are to be regarded as a source of health during the winter. This suggestion is an important one and, coming from a man who made an excellent record as commissioner of health in one of our largest cities, is one to which managers of electric-service companies should pay careful attention.

If every schoolhouse were equipped with electric fans for both summer and winter operation, a practical result would be a greatly extended use of this class of apparatus and of the energy necessary to operate it. The demand for electricity to operate these fans would seldom come on the peak, even during the shortest winter days. The question has, however, a broader and more important aspect than the mere advantage to electric-service companies, although this need not be overlooked, and managers of electrical utilities may well make some study of the possibilities of electric ventilation in schoolhouses, taking up the subject with the various school boards as opportunity arises. In particular it would seem as though all new schoolhouses in cities should be wired throughout for electric service, so that the advantages of direct electric ventilation in every room may be obtained thereafter at comparatively small cost.

REPLACING ISOLATED PLANTS WITH CENTRAL-STATION SERVICE IN ST. LOUIS.

Owing to the presence of cheap coal, at $1.40 per ton f.o.b. St. Louis, from the nearby Illinois bituminous fields, St. Louis has had perhaps more than its share of isolated lighting, power and heating plants. Good headway in the conversion of these installations to central-station service is now being made, however, as the result of the intelligent and effective campaign which has been waged for several years by the Union Electric Light & Power Company, which is rapidly acquiring former isolated plants as its customers and preventing new plants from being installed.

In the *Electrical World* of July 29, page 276, a note reported the conversion of two of the largest of such plants in the city to Union Electric service: the 850-kw Grand Leader department-store plant and the 500-kw Cupples Station plant, having three direct-connected engine units and two steam turbines. The sixty-nine hydraulic elevators at the Cupples plant are to be operated the year round by centrifugal motor-driven pumps. The Cupples plant furnishes service under a city franchise to offices, warehouses, etc., throughout a terminal railroad district covering fourteen city blocks. In these cases central-station lighting service is supplied during the summer, while the isolated plant returns to operation during the peak-load periods and to the extent of exhaust-steam heating requirements from October to April, the former station being under the Union Electric Company's control.

This summer lighting service to buildings supplied from private combination heating and lighting plants during the winter has proved one of the opening wedges in finally ousting the isolated equipment. The owners of the plants are usually glad to shut down during the warm months, when steam heating is not required, thus excluding excessive heat, smoke and dirt, and since this additional load comes during the summer period and off-peak winter hours when the central station's demand is light the arrangement is equally satisfactory to the electric-light company. In some cases such an arrangement is continued each year, isolated plants returning to operation during the steam-heating season, generally under the control of the Union Electric Company, thus relieving the owner of the property from the burden and care of operating a plant. The Union company impresses on the owner that the time which he, personally, puts in on the plant could be better and more profitably applied to the business he understands. In many cases the isolated-plant operator thus has demonstrated to him the convenience and economies of central-station service and a good customer for the year round is secured. After the company has operated a plant as above for several years and the equipment becomes gradually worn out, replacements or extensive repairs being necessary, the owner of the machinery usually finds he is able to make a more profitable arrangement with the company for outside service the year round, operating his own boilers at low pressure for atmospheric heating service.

WHO ?
WHO Purchases the supplies for your power plant—the fuel, boiler compound, packing, belt dressing, oil, waste, gauge glasses, oil cans, belt lacing and the many other odds and ends— YOU?
WHO Receives the salesmen and listens to their voluminous arguments— YOU?
WHO Listens to the complaints about this oil and that boiler compound— YOU?
WHO Listens to the excuses for lack of power and SHUT-DOWNS— YOU?
What s your time worth? Add that to all your power plant bills and contrast the total with the cost of our central station power—power that requires none of your time—that comes to you ready to use —that is ALWAYS READY—always sufficient.
Houston Lighting and Power Co. 1905
Phone Preston 71 917 Capitol Ave. Houston, Texas

An Open Letter to Plant Owners at Houston, Tex.

As is characteristic of such installations in many other cities, office buildings, hotels and department stores are among the hardest classes of business to obtain. After solicitation of from one to five years, however, even these plants can usually be "shown" and become converted at once, or by degrees, to central-station service as outlined above.

With the permission of the owners experienced engineers are sent into the plants, the quantity of coal burned is measured, the engines are indicated and tests of various steam and power losses are made, evidence being acquired in this way of sources of expense which could be avoided with electric drive and district or isolated heating service furnished by the central-station company or the user, as may prove to be the less expensive method.

Where the consumer can really show that he is operating

his station at lower cost than he could purchase electric service and furnish his own low-pressure heating, and this the company's engineers find to be true, the Union Electric Company then makes the proposition of offering to operate the isolated plant either under its existing condition, with summer service and off-peak winter service from the company's lines, or as a low-pressure heating system; in the latter case using only the plant boilers and supplying electric-lighting service from its own lines the year round. With the electric company's expert staff of engineers and large facilities for buying fuel and supplies it is evident that the plant can be operated in this way more cheaply than as an isolated station under private direction, and the point of this argument, with others, usually appeals to the owner.

In several instances in St. Louis the Union Electric company has taken over isolated plants, operating these as auxiliary generating stations during the peak and at other times only to give sufficient exhaust steam for heating purposes during the steam-heating season. Under such conditions the local generators are connected with its own Edison distributing network, so that any energy generated on account of steam heating in excess of the demand in the building is delivered to the outside lines. When no heating is required these plants are shut down and electric service is supplied from the Ashley Street central station.

In other cases, as above noted, the company either converts the existing steam boilers into low-pressure units or installs its own steam-heating equipment, which is operated during the heating season. These decentralized heating plants also sometimes form the nuclei of localized steam-heating systems, the company often being able to go next door or within the same or adjoining blocks and replace other isolated electric plants, supplying winter steam from the boilers of the central isolated plant, while furnishing electrical energy from its main system.

An enumeration of a number of the large service installations of the Union Electric company was given in the *Electrical World* of May 19, 1910. As several additional large installations have been taken over since that time we give the following as examples of the class of business being handled:

	Cubical Contents.	Kw-Hours per Year from Central Station.	Kw-Hours Generated.	Connected Load Kilowatts.
Office Buildings:				
(1)	1,538,107	91,100	0	150
(2)	1,402,600	196,311	0	187.5
(3)	431,160	74,106	0	150
(4)	1,533,096	285,450	0	270
(5)	1,879,000	427,601	0	394.4
Department Stores:				
(1)	9,048,878	2,214,350	0	1556.8
(2)	7,800,000	1,150,000	850,000	850
Hotels:				
(1)	1,600,000	385,472	0	222.2
(2)	1,027,014	90,000	60,000	75
(3)	902,328	100,000	71,420	150
(4)	2,000,000	646,100	0	407.3
(5)	1,000,000	341,276	0	203.5

During the year 1910 isolated-plant business amounting to 2406 kw was connected and 2,417,261 kw-hours were consumed by this 1910 business during the same year. The kw-hours generated in isolated plants during this period was 463,300 and revenue for energy delivered from the company's lines to these isolated plants during the period mentioned was $76,900.91. The revenue for steam heat and generation during the same period was $22,590.38 and the total revenue from plants taken over in 1910 was $99,491.29, the average price for energy from the company's lines being 3.24 cents per kw-hour.

From Jan. 1 to Sept. 1, 1911, there has been connected to the company's lines isolated-plant business equivalent to 1912 kw in ten buildings. In one of these plants the capacity is 500 kw.

The Union Electric company is now figuring on installing a substation for a large building, contemplating the operation of the latter plant during the central-station peak-load period and to the extent of the heating requirements. This building will have approximately 12,000-kw generating capacity and a cubical capacity of 12,000,000 cu. ft.

It is not the Union Electric company's policy to make random statements regarding the cost of central-station service as compared to isolated-plant service, and it is the company's rule not to assert that central-station service would be cheaper when the company's representative knows in his own mind that the consumer could generate energy at a less cost than it could be obtained from the company's mains. The company goes on the theory that there are some installations which the central station cannot expect to get, provided the consumer is in a position properly to operate an isolated plant. The company claims that in some plants steam is used and required in great volume

ISOLATED PLANT DATA SHEET

Firm Name Business

Address Plant

DESCRIPTION

ITEMS	FIRST COST ISOLATED PLANT No. or Quantity	ISOLATED PLANT Dollars	UNION SERVICE No. or Quantity	UNION SERVICE Dollars	ITEMS	OPERATING COST PER ANNUM ISOLATED PLANT No. or Quantity	ISOLATED PLANT Dollars	UNION SERVICE No. or Quantity	UNION SERVICE Dollars
Building					Superintendent				
Engines					Engineers				
Boilers					Electricians				
Auxiliaries					Millwrights				
Fuel Tanks					Firemen				
					Coal Passers				
					Fuel or Current				
Air Compressors					Hauling Ashes				
Air Reservoirs					Water				
					Eng. Room Supplies				
					Maint. Bldg. and Aux.				
					" Boiler				
Generators					" Gen. and Switch.				
M.G. Sets					" Motors				
Rotaries					" Belt and Shafts				
Motors					Lamp Renewals				
Switchboards					Carbon Renewals				
Arc Lamps									
Incandescent Lamps					Interest				
					Depreciation				
Shafting Installed					Insurance				
Belting					Rent of Space				
Foundations					Taxes				
Piping									
Wiring					Dam. Ill. and Vibra.				
Installation					Rents				
AGGREGATE					AGGREGATE				

Remarks:

Salesman Date

Isolated-Plant Data Sheet.

for cooking and manufacturing purposes when the electric requirements are less than the steam, or when the electric requirements are sufficient to give the required exhaust steam for atmospheric heating purposes seven or eight months in the year without the use of live steam.

For securing the power business of large industrial establishments the company has on its staff a number of experienced motor-application engineer salesmen. A record is kept of all of the isolated-plant installations in St. Louis and calls are made on the owners of these stations to acquaint them with the advantages and economies of central-station service. In the course of these visits permission is requested for one of the company's engineers to go through the plant and study the cost of power production and distribution, with an idea of determining whether a saving would be made were such service furnished by the electric company. From the plant fireman and engineer information as to the expenditures for coal, oil and supplies is secured and estimates are made of the overhead costs, including interest and depreciation on the investment.

Indicator cards are taken from the plant engines and the sources of various losses in shafting, belting and other transmissions are located and investigated.

As a bit of salesmanship psychology it is interesting to note that after the test has been made on the plant the solicitor usually makes several calls on the owner, ostensibly with the idea of asking for additional information, but at each visit lets drop some hint of a source of loss that has been discovered in the plant's operation. One or two of these suggestions usually make the owner keenly interested in the proposal which the central-station company has yet to offer and the intelligent discussion which the company's representative is able to make with him on the peculiar subjects and phases of his own business begets further confidence in the mind of the owner. The company has in its employ men who are familiar with the power needs of a great many and widely diversified manufacturing processes and where the solicitor's own knowledge is limited he has recourse to the application data of the large manufacturers and other central stations. Discussion with the owner soon reveals the fact that the solicitor is perhaps better informed on methods of power application for his particular business than even the owner himself and the company's complete report, which is submitted later, is usually awaited with great interest.

These reports, which are now being prepared in a standard style, open with a description of the present equipment and an account of the tests made by the company's engineers on the prospective customer's plant, including an estimate of the present cost of operation. After this there follows in great detail a description of the proposed installation of motors, the arrangement of drives and machines being carefully shown. In thus preparing for electric drive, in addition to the well-known advantages of better light, less power, etc., a point is made of the logical arrangement of the processes of manufacture possible, requiring less handling of the product. Estimates of the size of motors, hours' use and operating costs with electric drive are then appended, a statement being made of the first cost of the new equipment, on which interest and depreciation are charged. The total operating cost under these conditions is then compared with the operating cost of the isolated plant. Sometimes it is even found possible to omit charging depreciation and interest on the steam plant, although including these on the motor drive, and still reveal a striking contrast between the two installations. Herewith is reproduced a copy of an isolated-plant data sheet which accompanies the report submitted to the owner, this sheet giving in compact form a summary of the costs that are explained at greater length in the report. As shown at the left the items of first cost are compared for isolated-plant and uniform service, and at the right the operating costs per annum for both services, all classified under a great number of headings.

The solicitation of isolated-plant business in St. Louis has been under the direction of Mr. Frank D. Beardslee, commercial engineer for the Union Electric Light & Power Company, and the industrial power business under the direction of Mr. L. F. Philo, sales manager. Mr. Herman Spoehrer, secretary, has general supervision over the commercial departments of the company.

POPULARIZING THE ELECTRIC LIGHT IN GERMANY.

As recently noticed in the *Digest*, the central station in Strassburg, Germany, has paid much attention to extending its business to small residences, and has met with much success.

Any number of lamps up to four per customer are installed at the expense of the electric-light company under the following conditions: The first lamp is installed entirely free of charge if four customers in the same building apply for service. In Strassburg, it should be added, there are comparatively few single-family houses. For the second, third and fourth lamp 6 cents is charged per month per lamp during six years. This corresponds at 4 per cent interest to $3.84 per lamp, which sum may be paid at the time of the installation. The cost of installing more than four lamps is paid by the consumer. The charges for service are 9.5 cents per kw-hour and 6 cents meter rent per month. The customer must contract to pay a minimum of $4.30 per year during the six years, or for one year at least in case he moves. Fixtures are to be paid for by the customer except one simple fixture in the kitchen. The above conditions correspond to an average discount of 10 per cent on the customer's bill.

The central station pays the following lump sum to local electrical contractors for these installations: 9 cents per foot of riser; $3.60 for the first lamp, $3.10 for the second lamp, $2.90 for the third lamp and $2.40 for the fourth lamp. If the costs should be higher in special cases the contractor makes an agreement directly with the customer about payment of the excess sum.

Electric light has become very popular as a consequence of this plan, and applications are made from many laborers' quarters. In one and one-half years 6200 installations have been made under this system, with an average of three lamps per installation and an average yearly income of $8.30. The central station sees to it that in each installation there is at least one 50-cp lamp. Only 7.4 per cent of the consumers fell short of the minimum bill of $4.30 per year. The rest, 92.6 per cent, pay considerably more than this minimum, but the amounts vary widely. Loss to the central station from unpaid bills is very small.

The president of the Strassburg company advocates a system of charging under which the customer would pay a certain fixed sum according to the number of rooms inhabited, which entitles him to use a certain number of watts at any time as long as he pleases. He would not be restricted, however, to that maximum demand, the energy consumed beyond to be measured by a watt-hour meter.

Wiring and Illumination

CONTRACTORS' EDUCATIONAL CAMPAIGN IN CHICAGO.

An interesting series of joint meetings of the electrical contractors of Cook County, comprising the members of the Chicago Electrical Contractors' Association and the Faraday Electrical Association, is in progress in Chicago. The first-named association embraces the principal "downtown" electrical contractors, while the Faraday association includes the smaller electrical contractors doing business outside of the "Loop" district in Chicago or in the suburban area within Cook County. The meetings are held monthly and have for their purpose the raising of the standard of electrical construction work in Cook County and also teaching the smaller contractors how to do business and how to keep their records to show whether the business is really profitable or the reverse. Many of the small electrical contractors are rather inexperienced in business matters, and the electrical jobbers have been known to say that the small electrical contractor constitutes the greatest credit hazard in the business. It is one of the purposes of the meetings in Chicago to raise the standard of the business generally, and to co-operate with central-station men, underwriters, dealers in electrical supplies and lighting fixtures and others to that end. The value of these joint meetings has been recognized by the Department of

Electricity of the city of Chicago, which has arranged a conference with the two societies of contractors to discuss the rules and regulations for the installation of electrical apparatus in Chicago. These rules call for a high character of construction work and are well enforced.

Mr. C. R. Kreider is president of the Chicago Electrical Contractors' Association, and Mr. R. C. Bierdemann is president of the Faraday Electrical Association. These gentlemen presided alternately at the joint monthly meetings. At these meetings a speaker is provided who gives a talk on some practical phase of the electrical contractor's business, from either the technical or the business point of view. Among these speakers have been Mr. Victor H. Tousley, chief electrical inspector of the city of Chicago; Mr. F. H. Getchell, electrical engineer for Holabird & Roche, architects, and Mr. H. B. Crouse, of Syracuse, N. Y., of the Crouse-Hinds Company. Such a meeting was held at a Wabash Avenue restaurant on Nov. 22, and there were about seventy-five men present. The speaker of the evening was Mr. Frederic P. Vose, secretary of the Electrical Credit Association of Chicago, who gave an excellent talk on "Organization." The meetings have a serious and worthy purpose, but entertainment features are also provided, and the gatherings are found to be very enjoyable. The next joint meeting of the contractors will be held in the middle of December.

RECENT STREET-LIGHTING DEVELOPMENTS IN PUEBLA, MEXICO, AND VICINITY.

By Roscoe Scott.

The purpose of this article, which is supplementary to that entitled "Street Lighting in Puebla, Mexico" (see *Electrical World*, June 1, 1911, page 1454), is to report the satisfaction felt by the people of Mexico's third city as regards their pioneer system of ornamental incandescent street lighting, and furthermore to note the interest it has aroused in other Mexican municipalities.

At the outset this opportunity may be taken to modify a statement made in the former description to the effect that "when the entire city has been lighted in this way, as is the present intention, there will be approximately 1000 lamps in service." The fact of the matter is that there are at present about 1000 lamps installed, and that whenever the system shall have been extended to cover the entire city there will be approximately 5000 lamps in service.

Despite the fact that the ornamental street lighting is costing slightly more than the open-arc system it replaced, the general consensus of opinion among the citizens is that the beauty and effectiveness of the installation more than compensate for the additional expense. Already a movement is on foot to extend the lighting. It is stated by the central-station officials as quite likely that within a short period the present equipment may be increased by from 50 to 100 per cent, and moreover that since the lights were first turned on not a single adverse comment on either the appearance or the illumination has to their knowledge been expressed. Fourteen city blocks are now ornamented by the five-light posts with the quaint brackets of griffin design, twenty-nine five-light posts are distributed throughout the Zocalo, or city park, and in addition the Portales surrounding the Zocalo are illuminated by 100-watt lamps. The present installation was completely finished by June 1 and has been in service every night since that date.

The accompanying photographs show three new views of Puebla streets after dark, or, more correctly speaking, after sunset. It will be noticed, in the background of Fig. 2 and in the foreground of Fig. 3, that the streets are festooned with high arches of incandescent lamps. These were installed in August, 1910, and were lighted every night of the following month in honor of the Sixteenth of September, which last year marked the centenary of Mexico's independence. Intended originally for temporary use only, the arches were left in place by order of the City Council, and have been illuminated on all succeeding national holidays and other special occasions.

Just after the nominal cessation of hostilities in the recent Mexican revolution Puebla was the seat of much rioting and turbulence, to such an extent indeed that railroad communication with the city was for a time practically suspended. Throughout this period of violence, however, the street lamps and globes appear to have been exempted from all vandalism. The unabated interest in street-lighting improvements—not only in Puebla but in other Mexican cities, as will be noted below—incidentally speaks forcibly for the ability of the country to recuperate after a strife which so heavily drained its resources.

Figs. 1, 2 and 3—Ornamental Street Lighting in Puebla, Mexico.

Careful records of the performance of the 100-watt,

4-amp series lamps are being kept by Mr. J. C. Riach, general manager of the Puebla Tramway, Light & Power Company, but it is not thought that average figures of sufficient value to warrant their publication will be available before June 1, 1912.

As a result of this first installation of metal-filament series lamps on poles in Mexico, many electrical companies in that republic have interested themselves in the possibility of accomplishing similar results in their own territory. Among the places where special activity has been manifested may be mentioned Vera Cruz and Mexico City. The following statements are quoted verbatim from the *Mexican Herald,* an English daily printed at the capital, for Oct. 16, 1911, and refer to an installation of high-efficiency incandescent street lighting recently made by the Mexican Light & Power Company on one of the prominent streets. The latter are at present lighted for the most part by open carbon arcs of German manufacture:

"The demonstration of effective street lighting made by the Mexican Light & Power Company in this city last night was a complete success. This demonstration was made in the two blocks extending along Avenida San Francisco from San Juan de Letran to Bolivar Street. Twenty-two lamp-posts, each equipped with a cluster of five lamps, were erected along the two blocks, and last night for the first time the light was turned on. The effect was magnificent. It is safe to say that never before in the history of Mexico City has there been such a brilliant and perfect illumination as was seen last night. The Sunday evening promenaders seemed immensely to enjoy the experience of thoroughly lighted streets, and the occupants of the long lines of carriages appeared as distinctly as in broad daylight. The idea of this effective street-lighting system has been taken from Puebla. If the government of the Federal District decides permanently to adopt the new system, the city of Mexico will very soon become the best lighted city in the republic."

RECENT TELEPHONE PATENTS.

MOUTHPIECE.

Where it is desired to make a transmitter mouthpiece of transparent material such as glass, or of some white impervious material such as glazed porcelain, some special holder arrangement is necessary to secure the mouthpiece to the transmitter. Numerous metallic holders have been suggested, but one about as simple as any is that described in a patent granted to Mr. F. O. Beuermann, of New York City. He molds his mouthpiece with an annular groove in the wall at the small end, where the wall thickens. This groove is of uniform depth save at one joint where a projection is left. A short tubular metal nipple threaded throughout its outer surface is coated with cement and pushed down into the groove with a nick in its edge spanning the tooth left in the groove. The projecting end of the nipple fits the transmitter case.

FIRE ALARM AND TELEPHONE SYSTEM.

Where a fire alarm is superimposed upon a telephone system and a code or number wheel is used, it is of material advantage for the operator to recognize signals definitely and immediately. Mr. W. L. Denio has therefore arranged a transmitter in the fire-alarm circuit so that the operator will receive a peculiar tone coincident with the code and thus immediately recognize the character of the signal and will plug it through to the fire department without delay.

RINGING APPARATUS.

Mr. H. N. Faris has obtained a further patent upon his ringing apparatus. This is of the pole-changer variety with a transformer the primary circuit of which is open save when there is a demand for ringing current. This demand is evidenced by the operation of the ringing key. The vibrator operates continuously, but a saving of current from the ringing battery is effected because of the open primary circuit.

REPEATER

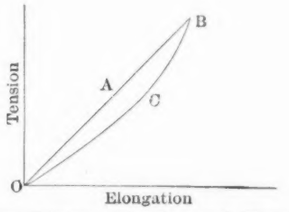
Some time ago we noted a patent for a repeater wherein the repeating direction of the apparatus was determined by the direction from which the exciting telephone current was received. The three patents recently issued to Mr. Charles Adams-Randall, of New York City, relate to a repeater and system of the same general type. One or more relays control the directional relation of the repeater or repeaters and this relay or these relays are in turn controlled by a push switch at the talking stations. Thus, if the button at one station be pushed, the transmitter of that station will have a relation to the repeater so that its currents will be sent to the distant end after being reinforced. If the button be not pressed then the station will be in receiving relation to the repeater. These patents are assigned to the Randall Telephone Manufacturing Company.

LETTER TO THE EDITOR.

Sags and Tension of Overhead Conductors.

To the Editor of Electrical World:

Sir:—The article in your issue of Nov. 11 by Mr. Alfred Still entitled "Sags and Tensions of Overhead Conductors" gives some very interesting and convenient methods for determining the mechanical constants of transmission lines. It occurs to me, however, in connection with the formulas which are developed in this and other articles recently appearing on the same subject that there is one factor not mentioned which should be taken into account in refined calculations. I refer to the failure of Hooke's law to apply to contraction as well as to elongation. That is, according



Relation Between Tension and Elongation.

to Hooke's law when a wire is subjected to tension the resulting elongation, if not carried beyond the yield point, will be very closely proportional to the force applied. However, if this tension is now gradually relieved, the decrease in elongation will not be proportional to the decrease in tension. As shown graphically in the accompanying illustration, the relation between tension and elongation will, as the tension is gradually increased, be given by the straight line $O\,A\,B$, but upon decreasing the tension the relation will be given by the curve $B\,C\,O$.

Owing to this property, when a span of wire which has been erected with a given sag and tension at a given temperature has been stretched from, say, a sleet load or a change in temperature, it will not return again to its original position when the conditions as to temperature and load return to what they were originally. That is, the wire will have a greater sag than that given by the formula. This is, of course, on the assumption that the elastic limit has not been reached.

To what degree this will increase the sag beyond the calculated value can best be determined by experiment.

Chicago. B. Smith.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Insulation Tests of Electrical Machinery.—A. P. M. FLEMMING AND R. JOHNSON.—The authors first point out the influence of temperature and moisture on insulation tests. In Fig. 1 a comparison of curves *A* and *B* shows the increase in insulation resistance resulting from the drying

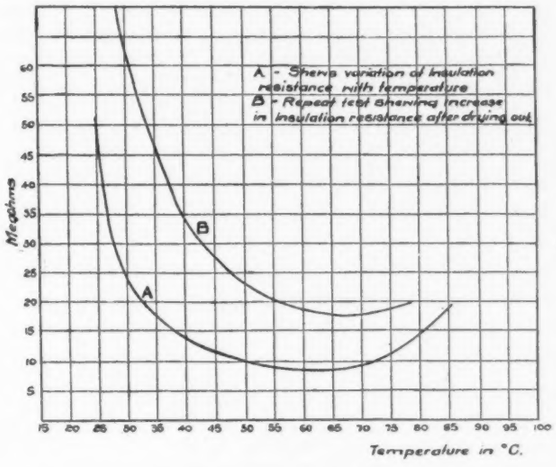

A - Shows variation of insulation resistance with temperature
B - Repeat test showing increase in insulation resistance after drying out
Megohms
Temperature in °C.

Fig. 1—Variation of Resistance with Temperature.

out of the windings of a 2000-volt induction motor where the insulation consisted of paper, mica and tape. The curves also show the effect of temperature on the insulation resistance and are typical of machines irrespective of the kind of insulation used, although as a general rule the decrease in insulation resistance as the temperature is raised is greater where organic materials, such as varnished papers and fabrics, are used than where those of a partly inorganic nature, such as micanite, are employed. The effect which moisture in the air has on the insulation resistance, however, should not be overrated, since in a moist atmosphere long before the slot insulation has absorbed sufficient moisture to affect appreciably the insulation resistance the exposed surfaces of the ends of the windings outside the slot portions will have become slightly conducting, due to deposits of moisture. The resistance will then be found to be greatly reduced solely through leakage over the surfaces from lightly insulated portions of the winding, or from bare copper, as in the case of direct-current machines. Particularly machines installed in chemical works have developed excessive leakage over the end of the windings due to the formation of conducting deposits. As regards pressure tests, these in general are only necessary during the time the machine is in the manufacturer's hands, that is, prior to putting it into service. The principal function of a pressure test is to determine whether there is any mechanical damage to the insulation between windings and ground. The test at the same time affords some indication as to the sufficiency of the thickness and quality of the insulating materials used. The principal risk likely to occur is that of the charring of the insulation due to internal heating, caused by the dielectric loss which is set up in insulation when it is subjected to alternating electrostatic stresses, this heating being more or less proportional to the square of the voltage. American and German practice of standardizing a test duration of one minute is recommended as reasonable. A danger not often recognized in applying pressure tests between windings of machines and ground lies in the possibility of causing short-circuits between adjacent turns of the coils. This is likely to occur if the test produces a breakdown to ground at a point in the winding or if a flashover occurs from the end of the winding to ground. In Fig. 2 the entire winding of the stator is represented diagrammatically by *A B*, and connection from the testing transformer to winding and ground is shown made at the two points *C* and *D*. If now failure occurs to earth at the point *E*, either through the breakdown of the insulating materials surrounding the coils or by a flashover from the windings across the air-gap to the armature iron, the potential at the point *E* is suddenly reduced to zero, and the full testing voltage is thrown across the portions of the winding *A E* and *B E*, the slope of potential being greatest across those turns nearest the point *E*. The momentary voltage across these turns may easily be sufficient to puncture the insula-

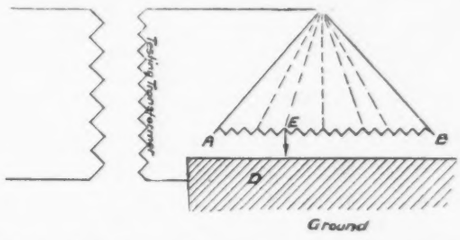


Fig. 2—Test Arrangement Shown Diagrammatically.

tion between them. The risk may be minimized by connecting the testing lines to as many points as possible on the winding, as indicated by the dotted lines. This also affords similar protection against the effect of surges liable to be set up if the testing voltage is suddenly switched on or off.—Lond. *Elec. Review*, Nov. 17.

Parallel Operation of Compound-Wound Generators.—C. I. YOUNG.—An article illustrated by numerous diagrams in which the author points out that it is a good plan to obtain a regulation curve on a generator after it has been connected to the prime mover with which it is to operate. The regulation curve furnished with a machine, though a correct record of test, may not give the operating characteristics in service, for the reason that the shape of this curve will depend to some extent on the speed regulation of the prime mover. After determining the regulation curve the next point is the consideration of the shunt resistance for the series field coils and the resistance to be connected between the series field coils and the busbar. In the majority of cases this is all that will be required. However, if after these adjustments the machines still fail to divide the load in proportion to their output ratings, it is in order to investigate the shapes of their regulation curve and see if some slight adjustment in the speed of either of the two prime movers, or perhaps both of them, cannot be made, such as will bring their curves more nearly in line. This can readily be done with belt-driven machines or with machines connected to direct-current motors, reciprocating steam engines or steam turbines in any but exceptional cases. With waterwheels or gas engines adjustment is not so easy. With induction motors the proposition is difficult. It is possible to secure slightly lower speeds by slotting the secondary end rings to increase their resistance, but higher speeds are practically impossible. If the adjustment of the shunt on the series field coils and the series resistance between the series field coils and the busbar is well made for each machine, and the regulation curves are lined up closely, the equalizer will have comparatively small corrective current

to carry. In many cases the generators are driven by prime movers with which speed adjustment is difficult or impossible. In such cases it may be necessary to put in an equalizer of larger size than the positive and negative cables between the machines. If the machines still refuse to divide the load properly, it is possible to help matters by inserting additional resistances in the series field circuits of both machines (the ratio of resistance of these two circuits being maintained), which will have the effect of making the ratio of equalizer resistance to the field circuit resistance lower and improving the operation, but at the expense of economy.—*Elec. Journal,* November.

Changing of Induction Motor from Two-Phase to Three-Phase.—D. C. McKeehan.—The difficulty arising in changing ordinary two-phase induction motors to three-phase is that the required three-phase voltage is usually out of range of those found in common practice. Thus, in investigating the matter of changing a certain 50-hp induction motor from 220 volts, two-phase, to 440 volts, three-phase, the voltages suitable for delta or star connection of the primary were found to be 320 and 550 respectively, while the only available supply was 440 volts. The motor was of a somewhat obsolete type, with revolving primary and stationary wave-wound secondary. It was started by closing the line switch and, after attaining full speed, short-circuiting the stator, as shown in Fig. 3*a*. The original winding

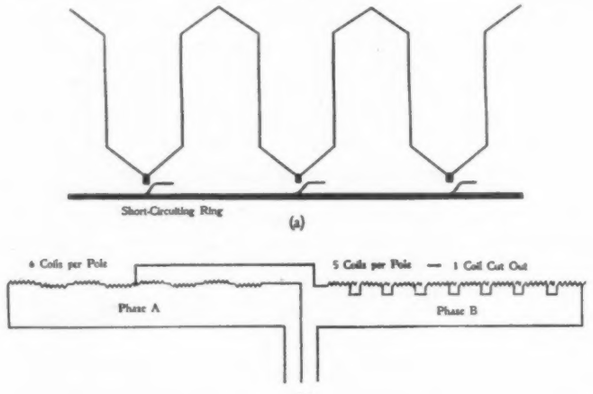


Fig. 3—Method of Changing Motor from Two-Phase to Three-Phase.

consisted of six coils per group, each phase winding being connected in two parallel circuits of four groups in series, that is, ninety-six coils in all. To adapt this motor for operation on the three-phase, 440-volt circuit available without altering its operating speed, the following changes were made: In the primary-phase winding *A* (Fig. 3*b*) the two groups (forty-eight coils) were connected in series, the ends being connected to the line. In phase winding *B* the groups were connected in series, but one coil of each pole was omitted from circuit. These idle coils were left in the slots, however, in order to maintain mechanical balance of the rotor. One end of this phase winding was connected to the line and the other end to the middle point of phase winding *A*. The method involves no new idea, as it is simply an application of the familiar three-phase to two-phase transformation scheme to an induction motor. It is applicable in cases where the two-phase motor is liberally rated, as the starting torque and maximum torque will be reduced considerably and the temperature rise at full load when operating as a three-phase motor will be about 35 per cent greater than as a two-phase machine.—*Elec. Journal,* November.

Transformers.—W. T. Taylor.—A paper presented before the (British) Institution of Electrical Engineers on modern high-voltage transformers in practice, with special reference to a three-unit T-system. The author discusses those questions which particularly interest the operating engineer, such as the operation of transformers in practice, their construction, losses, cost, comparative advantages, etc. The methods of connecting transformers are considered in detail.—Lond. *Electrician,* December.

Induction Regulator.—E. E. Lehr.—An article illustrated by diagrams giving details of polyphase induction regulator windings and describing a systematic method of determining whether the windings of a regulator which has been completed are correctly placed and connected.—*Elec. Journal.* November.

Lamps and Lighting.

Metallic-Filament Lamps.—A note on progress made in metallic-filament lamp manufacture. The increase of lamps made by the Allgemeine Elektricitäts Gesellschaft during the last year has been 60 per cent. On the other hand, the manufacture of carbon lamps by the same company has decreased by 10 per cent, while the manufacture of miniature carbon lamps has increased by 500,000 lamps. The chief progress in metallic-filament manufacture has been the reduction of cost and increase of strength of the filament, but there has been progress also in the reduction of specific power consumption, especially with high-candle-power lamps. The invention of ductile tungsten by the engineers of the General Electric Company of this country is also utilized by the engineers of the German Welsbach Company and the Allgemeine Elektricitäts Gesellschaft. On the other hand, Siemens & Halske own the patents for mounting wire-drawn filaments which they had taken out in connection with the tantalum lamp. For this reason the former three companies and the latter company have now pooled their patents so that they all can make ductile tungsten lamps according to the methods of the General Electric Company and can use the method of mounting the filament of Siemens & Halske.—*Jour. f. Gasbeleuchtung,* Nov. 18.

Switching On and Off of Metallic-Filament Lamps.—E. W. Marchant and W. Parry.—An account of experiments on the effect of frequent switching on and off of metallic-filament lamps on their efficiency and life. It appears that with a lamp having a life of 1500 hours this would be reduced to 1000 hours, that is by 33 per cent, by 72,000 switchings. From this it is estimated that a lamp normally operating 1000 hours if switched off once an hour—that is, 1000 times—would show a reduction of life of less than one-half of 1 per cent. In other words, in practice the effect of switching is negligible.—Lon. *Illumin. Eng.,* October.

Perception of Lights of Short Duration at Their Range Limit.—A. Blondel and J. Rey.—As to the perception of lights of short duration, Bloch originally contended that the excitation necessary to produce an appreciable sensation was practically constant and proportional to the product of the illumination and the time. Charpentier, who verified this law between certain limits, likewise suggested that the retinal impression e produced by an illumination E of short duration t is fixed according to a linear law $e = E\,t$. But it has later been suggested that this law must be replaced by one in which the period of perception of a light just capable of producing the threshold of sensation should be infinite and the equation should be of the form $(E - E_0)\ t = C$, when C is a constant quantity. The present authors have made a great many measurements with a large number of observers and have found that when uniform lights are used the law is $(E - E_0)\ t = a\,E_0$, when E_0 is the minimum perceptible illumination and a a constant of time of about 0.21 second. An application is made to the technics of flashlight.—Lond. *Illumin. Eng.,* October, November.

Generation, Transmission and Distribution.

Group and Individual Drive.—H. E. Popcke.—An article in which the author compares group and individual drive in machine shops and gives comparative figures of cost of installations and cost of the energy for friction loss. He

thinks that if the proper motor is used for individual drive the difference between the cost of individual and group drive is not large, if a new shop installation is considered, and will be paid for in two years' average. Instead of investing money in shafting and belting, it can be more economically invested in the purchase of electric motors for individual drive. The higher the cost of energy the greater is the advantage.—*Elec. Journal,* November.

Electric Power.—V. L. BOARD.—An article illustrated by diagrams on motor drive for biscuit factories.—*Elec. Journal,* November.

Traction.

Traction Power Plant in Hamburg.—W. WECHMANN.—The first part of an illustrated description of recent enlargements of the power plant and transmission line of the suburban single-phase traction line from Blankenese to Ohlsdorf. Two new turbo-generators, each of 1250 kw, have been installed with accessories.—*Elek. Zeit.,* Nov. 16.

Wheel-Base to Radius of Minimum Curve.—An article giving a diagram which permits one to determine quickly the minimum curve that a locomotive or car with a certain rigid wheel-base can negotiate, or the maximum wheel-base that can negotiate a given curve.—*Elec. Journal,* November.

Electrophysics and Magnetism.

Emission of Electrons by Metals Under the Influence of Alpha Rays.—H. A. BUMSTEAD.—An account of an experimental investigation which shows that the emission of electrons by aluminum and gold foils under the influence of alpha rays (secondary delta rays) varies with the speed of the alpha rays in a manner entirely analogous to the variation in the gaseous ionization produced by alpha rays. The emission at first increases and then rapidly decreases as the alpha rays near the end of their range, and the curves obtained show all the characteristics of the ionization curves in gases first obtained by Bragg. The curves lie within (to the left of) the corresponding curves for gases and have a less conspicuous "knee." So far they are in agreement with the known results on the retardation of alpha rays by metals, and with the hypothesis that the loss of energy by the alpha particles is due to an ionization of the metallic molecules. But the close similarity in the behavior of gold and aluminum is not in accordance with this view. In view of the dissimilarity in the ionization curves of different gases, the agreement in the curves obtained for aluminum and gold is unexpected, and leads to the suspicion that the observed effects may not be due to the metals themselves, but perhaps to a layer of absorbed gas in both cases.—*Amer. Journal of Science,* December.

Induction Coil.—E. T. JONES AND D. E. ROBERTS.—An account of experiments in which the authors investigate the elements (periods, amplitudes, damping factors and phases) of the two electrical oscillations which are set up in the secondary of an induction coil when the primary current is interrupted, and of calculating hence the maximum value of the secondary potential and the potential at any time during the oscillations.—*Phil. Mag.,* November.

Electrochemistry and Batteries.

Electric Reduction of Iron Ores.—O. FRICK.—A very extended and detailed analysis of the results obtained in the experiments made on a large scale at Trollhättan, Sweden, and in the Noble furnace at Heroult, Cal., together with a discussion of the improvements which may be made. The results of the analysis are given in various tables of figures.—*Met. and Chem. Eng'ing,* December.

Italy.—R. CATANI.—A paper reviewing the application of the electric furnace in the metallurgical industries of Italy with special reference to the production of steel and pig-iron in the electric furnace and the manufacture of ferro-alloys.—*Met. and Chem. Eng'ing,* December.

Aluminum.—G. FLUSIN.—After a historical sketch of the aluminum industry the author gives an outline of the present electrolytic process and then deals at some length with the preparation of the starting materials bauxite, alumina, cryolite, fluxes and electrodes.—*La Houille Blanche,* October.

Electroanalysis.—C. A. PETERS.—An investigation of the electrolysis of sodium chloride with a silver anode to hold the chlorine and a mercury cathode to absorb the sodium.—*American Journal of Science,* November.

Units, Measurements and Instruments.

Standardization Rules.—A long editorial discussion of the recent changes made in the standardization rules of the American Institute of Electrical Engineers. As to voltages it is pointed out that the rules now recommend the adoption on low-tension, continuous-current circuits of the following pressures: 115, 230 and 550 volts, as against 110 and 220 volts in the previous edition of the rules, issued in 1907. These last-mentioned voltages, however, have been retained for alternating-current circuits, being also supplemented by pressures of 440 and 550 volts. "We do not know what consideration influenced the committee in making the change in the case of continuous-current circuits from 220 to 230 volts, but it is to be regretted that the same pressure could not have been retained as standard for both continuous and alternating-current circuits." No change is made in the frequencies recommended, namely, 25 and 60 cycles. "The fact that the larger is not, even approximately, a multiple of the smaller is unfortunate. In this connection the 25 and 50 cycles favored in this country (England) are an improvement." As to notation it is thought that the use of three separate fonts to denote magnetic flux, magnetic density and magnetic force is "certainly not advisable; while as I, E and R are now to be internationally adopted for electrical quantities, we hope that their use also for photometric units, as suggested in the American rules, will be reconsidered before their employment for this purpose has become at all general."—Lond. *Electrician,* Nov. 17.

Series Transformer.—P. G. AGNEW.—A long account of a study of the series transformer with particular reference to iron loss. While the ratio of transformation of series transformers usually decreases with increasing current, it may increase in individual cases, or even pass through a maximum. The ratio and the phase-angle performance may be accurately computed from the magnetic data of the core. In general, the slope of the ratio curve may be qualitatively predicted from the value of the Steinmetz exponent if the latter be assumed to be constant. But the iron losses, particularly at the low flux densities used, depart too widely from such a simple law for accurate work. The slope of the ratio curve may be accurately computed from the slope of the curve obtained by plotting the core loss against the flux on logarithmic co-ordinate paper. It is proposed that this logarithmic slope or logarithmic derivative shall be called the ratio of variation. It is much more useful than the actual exponent. The methods now in use for determining the "exponent" fail to give a true exponent that will satisfy the equation $W = KB^z$, unless z is a constant. The quantity actually determined by these methods is the ratio of variation. The wave-form of the secondary of a series transformer may be considered to be the same as that of the primary current for even the most precise measurements, as the distortion within the transformer is entirely negligible. While the effect of variations in wave-form on ratio and phase angle may be detected by accurate measurements, it is too small to be of practical importance, being of the same order of magnitude as the effect of small changes in frequency. The null methods used for accurate determinations of ratio and phase angle all give the theoretically correct results, well within the experimental error, so that the accuracy attainable is decidedly greater than is required in practice.—*Bull. Bureau of Standards,* Vol. VII, No. 3.

Comparison of Voltmeters and Ammeters.—T. T. Fitch and C. J. Huber.—An account of a comparative test of switchboard voltmeters and ammeters of American make at the Bureau of Standards. The first tests related to the performance of the instruments. The errors of calibration were found to be small in all the voltmeters, but much greater (and in some cases excessive) in the ammeters. The power loss in direct-current voltmeters is so small as to be unimportant. Further tests were made as to change in indications due to standing under load (zero shift, etc.), effect of stray field, damping, mechanical balance of moving system, insulation resistance, temperature coefficient and ruggedness of moving system. The second comparative tests related to details of construction, especially of the moving systems (torque, weight, number of turns, ratio of torque to weight) and the magnets (dimensions, air-gap, etc.).—*Bull. Bureau of Standards,* Vol. VII, No. 3.

Grouping of Series Transformers.—An article illustrated by diagrams discussing five usual methods of grouping series transformers with special reference to the methods of reversed V-connections and Y-connections.—*Elec. Journal,* November.

Telegraphy, Telephony and Signals.

Copenhagen.—F. Johannsen.—An article giving statistical data on the telephone system of Copenhagen, which is one of the most extensively developed systems of Europe. It has about as many connections as Hamburg, with twice the number of inhabitants, or Vienna, with four times the number of inhabitants. Paris, with 2,500,000 inhabitants, has 45,000 connections; Copenhagen, with 500,000 inhabitants, had 31,000 connections at the end of 1909. The increase has been made chiefly during the last six years, as the number of the connections in Copenhagen increased from 19,000 in 1905 to 31,000 in 1909. At the same time the number of telephone conversations per day and per subscriber has decreased from 9.1 in 1905 to 8.2 in 1909. Since 1908 four-party lines have been added, and the 1600 subscribers on these lines carry on an average of a little less than one conversation a day. The accompanying figures give an analysis of the different classes of subscribers and their number of conversations:

Number of Conversations per Year.	Percentage of Subscribers.	Percentage of Conversations.
Below 1000	33	10
1000 to 2000	33	20
2000 to 4000	18	20
Above 4000	16	50

"Small" subscribers get a low rate, and the technical equipment of their lines is made as cheap as possible. On the other hand, for the "large" subscribers with a great many conversations during the day it is more economical to install an expensive equipment in order to reduce as much as possible the cost of operation. The equipment of the lines for the different classes of subscribers, as well as the charges and methods of operation, are described in some detail. In summing up the results it is concluded that the purely automatic system would not be successful if a great many small consumers had to be taken care of. But it is thought that the semi-automatic system, as used by the Bell company in this country and also by the Independents, may prove the solution for the future.—*Elek. Zeit.,* Nov. 16.

Long-Distance Wireless Telegraphy.—L. W. Austin.—An illustrated account of quantitative measurements carried out with long-distance wireless telegraphy up to 1000 miles for the purpose of determining the law of the variation of strength of signal with distance. Over salt water the electrical waves decrease in intensity in proportion to the distance as found by Duddell and Taylor. In addition, they are subject to an absorption which varies with the wave-length. This is true in general for day transmission. The absorption at night is entirely irregular, varying from zero to the day value, but is on an average much less during the winter than in summer. Variations also appear to occur during the daytime, but these are probably in general small. The received antenna currents between two stations with salt water between are proportional to the product of the heights of the sending and receiving antennas and inversely proportional to the wave-length, provided the antenna resistances remain constant. The experiments recorded were carried on with flat-top antenna heights of from 30 ft. to 80 ft. and wave-lengths of from approximately 1500 m to 4000 m.—*Bull. Bureau of Standards,* Vol. VII, No. 3.

Wireless Telegraphy.—A. Blondel.—A mathematical paper illustrated by diagrams on the use of two antennas for determining the direction in which a wireless message is received. Two different methods of orientation are discussed and the results of analysis are given in diagrams.—*La Lumière Elec.,* Nov. 4.

Wireless Telegraphy.—A continuation of the detailed and profusely illustrated description of the Telefunken system of wireless telegraphy. In the present instalment the equipment of various stations on board ship and portable military stations is described.—Lond. *Electrician,* Nov. 17.

Miscellaneous.

Reinforced Concrete.—P. Lecler.—A paper, illustrated by numerous diagrams, on the applications of reinforced concrete in electrical engineering, especially for switchboard partitions, conduit construction and the reinforcement of wooden poles without interruption of service.—*La Revue Elec.,* Nov. 10.

Insulating Material.—A note on a recent British patent (No. 5165, Nov. 9, 1911) of the British Thomson-Houston Company (General Electric Company of this country). This comprises a sheet of fibrous material, which is impregnated with a composition containing a phenolic aldehyde condensation product, and a stearine pitch. These are dissolved in a common solvent, such as amylacetate, the solvent being allowed to evaporate after impregnation. This gives a flexible material, which maintains its resistivity.—Lond. *Elec. Eng'ing,* Nov. 16.

Oxy-Acetylene Welding.—A paper by F. Carnevali giving hints as to the precautions to be taken in welding of medium and high-carbon steel as well as of cast iron by the oxy-acetylene flame. A separate article by Aug. S. Neumark discusses the production of oxygen in the workshop from alkali-chlorates.—*Met. and Chem. Eng'ing,* December.

Book Reviews.

The Copper Handbook. A Manual of the Copper Industry of the World. Vol. X. By Horace J. Stevens. Houghton, Mich.: Horace J. Stevens. 1902 pages. Price, $5.

The tenth annual edition of the "Copper Handbook" contains 1902 octavo pages, and in addition to the miscellaneous chapters lists and describes 8130 copper mines and copper-mining companies in all parts of the world. The descriptions range from two or three lines, in the case of dead companies, wherein reference is made to detailed descriptions in past volumes at the period of their activity, up to twenty-one pages in the case of the Anaconda mine, which yields one-eighth of all the copper made in the world.

The miscellaneous chapters of the book, twenty-four in number, treat the subject of copper from all possible viewpoints, there being chapters on the history, chemistry, mineralogy, metallurgy, brands and grades, alloys and substitutes for copper, with a copious glossary. A chapter of statistics ending the book contains about forty tables, thorough-

ly covering copper production, consumption, movements, prices, dividends, etc. The "Copper Handbook" is sold on a plan adopted nine years ago, the compiler sending the book by mail, prepaid, to any address ordered, without advance payment of any sort and subject to return after a week's inspection.

THE THEORY OF ELECTROMAGNETISM. By G. T. Walker, M.A., Sc.D., F.R.S. London: Cambridge University Press. 52 pages, Price, 3s.

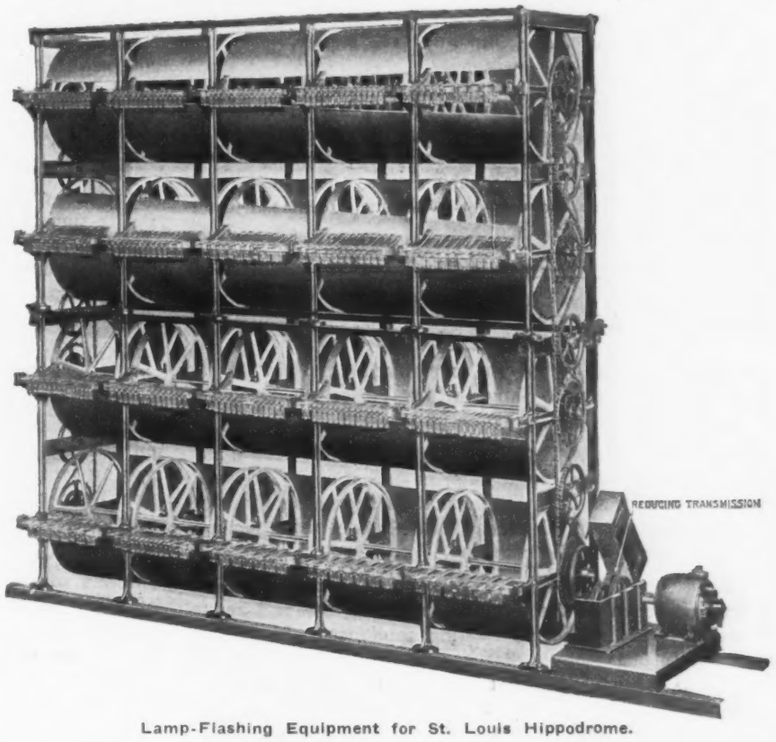
A short but advanced mathematical textbook on the vectorial theory of electromagnetism. There are seven chapters, which deal respectively with the following topics: Vector analysis; applications of vectorial methods to magnetostatics; the theory of Maxwell as expressed by Hertz; Hertz's equations for moving media; some effects due to the motion of charged particles through a stationary ether; the electron theory of Lorenz applied to stationary media, and the electron theory of Lorenz applied to moving media. The conclusion reached in the book is that Maxwell's equations as developed by Hertz are not in conformity with the experimental facts of optics in certain particulars, whereas the theory of Lorenz is in conformity with those facts. The conditions of relativity, or at least some of them, are deduced from the Lorenz theory in the manner originally demonstrated by Lorenz.

In these days, when the doctrine of relativity tends to become a cult and almost a religion, it is comforting to see it treated as a corollary to certain mathematical equations based on the behavior of moving electrons.

New Apparatus and Appliances

LAMP-FLASHING EQUIPMENT FOR ST. LOUIS HIPPODROME.

Talbot's Hippodrome is a large and handsome new theater in St. Louis. It is located at Sixth and Locust Streets, and is made conspicuous at night by a scheme of façade lighting of which the effect is similar to that which would be produced by an artist who made an outline sketch of the principal architectural features of the front of the building. This flashing of the spectacular outline lighting on the building front is accomplished by means of a lamp flasher of unusual interest, which is illustrated herewith. This mechanism, which is 6 ft. high and 8 ft. long, is one of the largest in service at the present time and has 232 switches of various carrying capacities, operated on 18-in. drums. The arrangement is for 191 changes, and the total number of lamps controlled by this machine is about 8000. The lighting load controlled is about 4000 amp at 10 volts, low-voltage tungsten lamps being used. A ⅓-hp, 110-volt direct-current motor drives the switching mechanism through a set of reducing gears which reduce the speed of the armature shaft in the ratio of 2500 to 1. The Reynolds Electric Flasher Manufacturing Company, of Chicago and New York, was the maker of this interesting combination.



Lamp-Flashing Equipment for St. Louis Hippodrome.

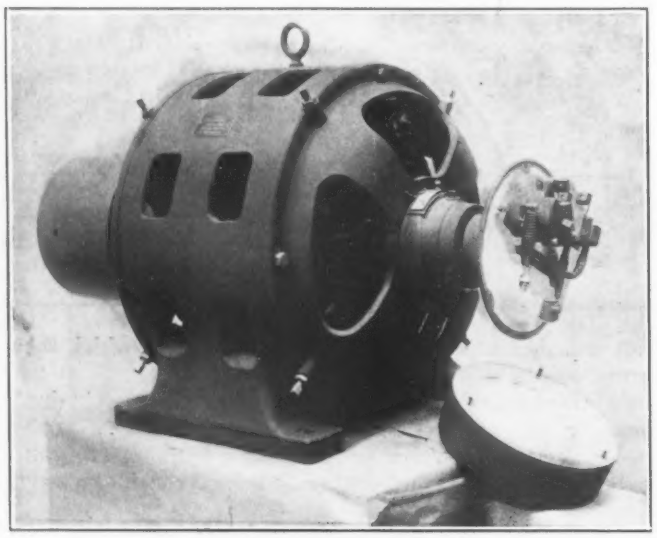
Fifty seconds is consumed in the operation of flashing the lamps on the entire theater front. The flashing begins by first throwing into circuit the semicircular cornice over the middle portion of the façade. The lamps come on one at a time in a manner similar to that observed in the script-writing effects often seen in electric signs. Other rows of lamps come in in the same manner, and light up in regular order various designs of the architectural ornamentation. The cornices and outlines on each side of the central portion next come into view, then the intervening sections and finally the window outlines, one at a time, until all the principal features of the front of the building stand out in lines of light. As stated before, the effect is as though an artist had sketched in the principal outlines of the façade, and the appearance is novel and striking. When the entire building front is outlined the lamps burn for seventy seconds and then are extinguished in the order in which they were lighted.

Electrical energy at 110 volts, direct current, is obtained from the Union Electric Light & Power Company. By the use of a rotary converter, alternating current at 110 volts is obtained, and this is reduced to 10 volts through two large transformers. Tungsten lamps operated at this voltage are used for the spectacular lighting. The sockets were made by the Federal Electric Company and are set in copper troughs.

The lamps are placed very close to one another, and when all the architectural features of the front of the building are outlined in light the effect is very brilliant. The flashing scheme was worked out by Mr. Bert Volker, electrician for Talbot's Hippodrome and the chief engineer for the Reynolds Electric Flasher Manufacturing Company. Including the flasher, rotary converter, transformers, wiring, cut-out blocks and lamps, complete, it represents an outlay of about $15,000.

INDUCTION MOTOR WITH AUTOMATIC STARTER.

In the accompanying illustration is shown an induction motor designed for providing a high starting torque with low starting current and yet to operate at high efficiency with low slip. The machine's centrifugal short-circuiting device closes automatically at a predetermined speed and thereby converts the secondary from a high-resistance to a low-resistance circuit. When a wider range of torque



Induction Motor with Automatic Starter.

and current variation is desired use is made of the "star-delta" scheme of change in interconnection of the three primary-phase windings of a three-phase machine. By making this latter change at a sufficiently high speed the current is kept within reasonable limits. This motor has been developed for the market by Bruce, Peebles & Company, Ltd., Edinburgh, Scotland.

EXHIBITS AT LOS ANGELES ELECTRIC SHOW.

Following is a list of the commercial exhibits at the Los Angeles Electric Show, which closes on Saturday, Dec. 9:

American Multigraph Sales Company, Cleveland, shows the Gammeter multigraph in operation. Cards and circulars are printed with information regarding the electrical show. Mr. O. C. Haney, branch sales manager, Los Angeles, represents the company.

Baker-Chase Electric Company, Los Angeles, exhibits a line of electrical fixtures for residential use and an attractive display of electric heating appliances. Mr. E. W. Chase is in charge.

Bell & Jamison, Los Angeles, representing the Electric Railway Improvement Company, Cleveland, show one of the company's bonding cars for electric-weld rail bonding. The car is placed upon rails and practically demonstrated. Messrs. Bell, Jamison and W. A. Bly are in attendance.

Columbus Electric Vehicle Company, Columbus, Ohio, displays an inviting line of electric vehicles. The company provides ample floor space upon a platform at the side of the hall, setting forth its display to excellent advantage. Mr. G. R. Beach is in charge.

Crocker-Wheeler Company, Ampere, N. J., shows an assortment of small motors. Mr. W. B. Palmer, of Los Angeles, is in charge.

Cutler-Hammer Manufacturing Company, Milwaukee, represented by Mr. W. B. Palmer, Los Angeles, exhibits a line of electric-heating appliances, electric irons and electric disk stoves. Many of the company's well-known controlling devices are also shown. Mr. Palmer is in attendance. Mr. Palmer has attractively arranged both of the above displays on either side of the auditorium stage, reserving the center for his spectacular effects, of which an account is given elsewhere in a general description of the show.

Detroit Electric Vehicle Company, Detroit, has an attractive automobile exhibit of both pleasure and commercial vehicles. Mr. I. H. Stratton represents the company.

Dictaphone Company (Columbia Phonograph Company), New York, represented by the Southwest Sales Company, Los Angeles, displays a complete line of its electrically operated dictaphones, practically demonstrated. Mr. Warden is in charge.

Duntley Manufacturing Company, Chicago, represented by F. G. Kingston & Company, Los Angeles, has a well-arranged booth displaying its vacuum cleaners and air purifiers. Mr. Kingston is in attendance.

Electrical World, New York, has an attractive corner booth, centrally located, displaying samples of the *Electrical World, Engineering Record, Electric Railway Journal,* and electrical books. Mr. C. A. Rowley is in attendance.

Empire Electric Company, Chicago and Los Angeles, has a large and attractive exhibit upon the balcony floor. The company's space is well arranged to display its portable and instantaneous X-ray equipment, high-frequency apparatus, mineral tubes and like specialties. The company's display represents local manufactured products. Mr. E. J. Rose, inventor for the company, is in charge.

J. C. Farrar & Company, Los Angeles, show a line of insulators of various types for high-tension work, interior power-station protective apparatus and similar equipment. The company represents the Ohio Brass Company and exhibits a handsome assortment of this company's specialties. Messrs. J. C. Farrar and W. M. Cook represent the company.

Gans Brothers, Los Angeles, electrical contractors and dealers, exhibit a complete line of electric appliances for household use, including washing and wringing machines, electric-heating apparatus and the like. The company has an attractive feature in a miniature machine shop, comprising lathe, drilling machine, shaper, etc., in full operation, by means of a small motor, shaft and pulleys. Messrs. Gans are in charge.

The General Electric Company has one of the largest exhibits of the show. One section is devoted to motors of all types, automatic starters, controllers, mercury-arc rectifiers and other similar equipment. Another section is devoted to smaller apparatus, such as meters, fans, sockets, lamps, etc., while a third section displays the company's line of electric household appliances, including chafing dishes and cooking devices. At the front portion of its exhibit an attraction is offered by the operation of a three-phase motor under water in a glass-inclosed case. The company also shows an automobile battery-charging rectifier. The entire local office of the company alternates in attendance, under the charge of Mr. J. O. Case.

Great Western Smelting & Refining Company, Los Angeles, shows an attractive line of metals, such as babbitt, bar lead, etc., in charge of Mr. L. Swarts.

Haskins Glass Company, Wheeling, W. Va., exhibits an attractive assortment of its popular shades and globes, including the Haskins-Lucida reflectors. The booth is arranged in fitting manner to set off the display fully. Mr. H. P. Wallace, manager, is in attendance.

KELLOGG SWITCHBOARD & SUPPLY COMPANY, Chicago, shows a line of portable and wall telephone sets, displaying also the Delco ignition system. The company has an attractive booth in charge of Mr. C. F. Hartung.

KELMAN ELECTRIC & MANUFACTURING COMPANY, Los Angeles, shows a line of its well-known oil switches near the entrance to the exhibit. Mr. J. N. Kelman represents the company.

B. F. KIERULFF, JR., & COMPANY, Los Angeles, manufacturers' agents, representing the Fort Wayne Electric Works, the Sprague Electric Company and the General Incandescent Lamp Company, display the leading products of these three companies, as well as smaller electrical apparatus. Fort Wayne transformers, Sprague motors and a lamp assortment of the General Incandescent Lamp Company are well exhibited. Mr. Kierulff is in charge.

LOS ANGELES BRASS COMPANY exhibits a handsome line of brass lighting fixtures and fixture parts, as well as a display of its brass spinning and casting work. The display is well set off by an attractive setting. Mr. L. Swarts represents the company.

LOS ANGELES ELECTRIC VEHICLE COMPANY shows an electric automobile exhibit consisting of Edison pleasure and commercial vehicles. The Edison storage battery is also displayed.

LUITWIELER PUMPING ENGINE COMPANY, Rochester, N. Y., exhibits its deep-well pumping machinery in large and small units electrically operated. The display is well arranged near the entrance to the auditorium. The Los Angeles branch of the company is in charge.

NATIONAL ELECTRIC LAMP ASSOCIATION, Cleveland (engineering department), offers one of the largest displays of the exhibit with liberal floor space. Among the features shown is the well-known bronze Holophane tree, comprising "Mazda" lamps in sizes from 25 watts to 500 watts, with Holophane reflectors; a small metal display case, glass-inclosed, exhibiting thirty types of "Mazda" miniature units; a larger case of regular and high-voltage "Mazda" lamps of sizes from 25 watts to 400 watts; a display board showing a complete set of automobile lamps; a miniature Christmas tree aflame with small decorative units, and a wood display rack showing "Mazda" lamps employed for residential use, with decorative reflectors, such as Luceo and Fostoria. Mr. F. J. Blaschke represents the company; Mr. Glenn C. Webster, manager of the engineering department, is also in attendance.

OHIO ELECTRIC VEHICLE COMPANY, Toledo, presents an attractive display of electric automobiles, particularly of the pleasure type.

JOHN A. ROEBLING'S SONS COMPANY, Trenton, N. J., exhibits its well-known line of cables, wires and insulating specialties. The display is attractively arranged on the balcony floor and is in charge of Mr. L. W. Drake, of the Los Angeles branch of the company.

Exhibit of National Electric Lamp Association at Los Angeles Electrical Show.

SOUTHERN CALIFORNIA ELECTRIC COMPANY, Los Angeles, shows a complete assortment of electric cooking appliances, electric washing and wringing machines, electric toys and novelties. The company offers a coffee percolator to the person who guesses the number of currants in a large bunch which is strung about a wire. Mr. J. C. Rendler is in charge.

STANDARD ELECTRIC TIME COMPANY, Boston, has a handsome display of electric clocks, particularly featuring its program clock for school and similar use. An attractive assortment of electric time stamps is shown. J. J. Estabrook, Pacific Coast manager, San Francisco, represents the company.

STANDARD UNDERGROUND CABLE COMPANY, Pittsburgh, exhibits a complete line of cables, wires, terminals, junction boxes and similar specialities. The display is tastefully arranged. Mr. C. G. Pyle, Pacific Coast department, represents the company.

Tuttle-Stevens Manufacturing Company, Los Angeles, presents a handsome line of automatic insulated electric cooking cabinets. The cookers are well demonstrated and attract considerable attention. Messrs. Tuttle and Stevens represent the company.

U. S. Electrical Manufacturing Company, Los Angeles, shows a complete line of direct-current and alternating-current motors of various sizes, a full assortment of the different parts, speed regulators, and similar apparatus. Mr. Carl Johnson is in charge.

Warner Instrument Company exhibits an attractive display of its electric measuring instruments. The booth is fittingly decorated to set off the exhibit.

Woodill & Hulse Electric Company, Los Angeles, has a large display suitably divided into sections. The exhibit includes a complete line of electric cooking apparatus, electric household appliances, electric washing machines and similar appliances. A full assortment of condulets, sockets, lamps, wire and similar small construction specialties is shown. An attractive feature is presented in the "dictograph," which when a receiver is placed to the ear renders to those attending the show selections from an opera played at a local theater. A telephone line was leased for this purpose, the apparatus having been installed by Mr. E. H. Abbott. The booth is handsomely decorated with 250 4-cp lamps on the overhead framework, these having white and red globes. Mr. H. B. Woodill represents the company, with a large and able force of attendants.

Wurlitzer electric pianos and organs are well represented by a large display on the main floor. During the intermission of band concerts demonstrations are given on the various instruments, attracting considerable attention. Mr. William L. Glockler is in charge.

Periodicals.—In addition to the *Electrical World*, the *Journal of Electricity, Power and Gas* is an exhibitor.

COMBINATION STEAM TURBINE.

The result of balancing the advantages and disadvantages of impulse and reaction turbines has been the so-called "combination turbine" which was first successfully introduced in 1904 by Sulzer Brothers, Winterthur, Switzerland. In this system the high-pressure part of a reaction turbine is replaced by a single impulse wheel, in which the greater part of the drop of temperature is converted into kinetic energy, so that only slight drops and low temperatures fall to the share of the low-pressure stages. The intermediate diaphragms, with their packings, which are most troublesome in working, are dispensed with, the over-all length is rendered short, the weight is greatly reduced, the shaft is very rigid and the axial thrust is small. The design is intended to insure great economy of steam, absence of any risk in applying high degrees of superheating, little axial thrust and high efficiency. In brief, this turbine consists of an impulse turbine with partial admission as the high-pressure stage and a reaction turbine with full admission as the low-pressure stage. The following is a detailed description of the latest type of Sulzer turbine embodying these characteristics.

Fig. 1 shows a 10,000-hp turbo-generator, of which Fig. 2 is a longitudinal section. Fig. 3 shows the construction and the connection of the various regulating organs of the turbine, wherein the parts seen from the front of the turbine are cut in a vertical plane.

The shaft or rotor *B* (Fig. 2) consists of a hollow steel drum, machined inside and out, with solid, polished shaft-ends joined to the rotor by flanges.

The fastening of the blades is done without riveting or calking, and a ridge on the concave side of the drop-forged distance block corresponding to a notch in the back of the blade firmly secures the latter. The high-temperature blades are made of steel and the low-temperature blades of bronze.

The letters which appear in Fig. 2 and Fig. 3 represent the following parts:

A,	Impulse wheel.	K,	Nozzle chamber.
B_1,	B_2 and B_3 Reaction drum.	M,	Steam exhaust branch.
C,	Thrust balancing disk.	N,	Hydraulic governor.
D,	Bearings.	O,	Supporting feet.
E,	Elastic coupling.	P,	Oil servo-motor for governor.
F,	Live steam inlet.	Q,	Safety or emergency stop-valve.
G,	Main stop-valve.	R,	Safety or emergency governor.
H_1,	Main throttle valve with yoke and governing gear.	S,	Oil pump for bearings.
		T,	Shaft packings.
H_2	and H_3, Auxiliary valve with yoke.	U,	Tachometer.
		W,	Speed-changing adjustment
I,	Engineer's foot-plate with lever for drain-cock and change-over valve, if any).	Z,	Oscillating device.

Seamless rolled shroud rings are shrunk on around the blades of the impulse wheel *A*, thus closing the steam passage on the circumference. Lubrication is effected by cooled oil circulated under pressure. The shaft packings are not affected by longitudinal displacement of the shaft and require neither lubrication nor readjustment. They consist of a large number of thin brass segments, ground to the diameter of the shaft and tightened up into firm packets with interposed segments of wider bore. A specially designed coupling *E* is employed to joint the shaft of the turbine to that of the generator. This coupling is arranged to compensate differences in the position of the two shafts. The slight axial thrust which arises from the low-pressure side is taken up in the smaller sizes by a simple collar thrust bearing and in the larger sizes by an oil-balancing disk *C*. The oil is delivered by a pump into the space between the thrust-balancing disk and the thrust block. Thence it escapes through the annular slot at the periphery of the disk, which is narrowed in proportion as the axial thrust increases, thus automatically regulating the oil pressure.

The most characteristic feature of the turbine is the oil-pressure system (Fig. 3). Oil is used not only for the lubrication of the bearings, but part of it serves to operate all the controlling and safety mechanism of the turbine, namely, governor *N*, servo-motor *P*, speed-changing device *W*, overload valves H_2, H_3, emergency governor *R*, thrust-balancing disk, emergency stop-valve *Q* and change-over valve to work "non-condensing." The oil pump *S*, worked by the worm-driven transversal shaft, keeps the pressure of the oil system constant at about 22 lb. per square inch. After circulation all oil is collected and conducted into coolers and filters upon which it is drawn up by the pump for use over and over again.

The governor *N* consists of a centrifugal pump impeller keyed on the same transversal shaft as the oil pump. The additional pressure generated by the impeller acts upon a spring-loaded piston valve and upon the servo-motor piston which controls the steam admission valve. Any change of oil pressure, that is, speed of the turbine, causes a displacement of the spring-loaded piston valve, thus admitting oil to the servo-motor or relieving the same. The difference of speed between full load and no load depends upon the law in accordance with which the force of the spring varies.

Rough regulation is effected by opening or closing whole groups of nozzles, but fine regulation is obtained by throttling. In order to increase the precision of the governing action by eliminating the friction of rest an oscillating device *Z* acts upon the oil system and keeps the whole column of oil, and all the parts connected therewith, in constant motion. The speed-changing device *W* can be worked by hand or from the switchboard while the turbine is running. It consists of a reduction valve, admitting oil to the upper face of the spring-loaded piston valve of the servo-motor, thus supplementing more or less the force of the spring.

By alteration of the passages of the speed-changing valve the turbine speed can easily be fixed within the necessary limits.

To prevent racing of the turbine there is provided an emergency governor R the centrifugal weight of which is arranged to form a slide-valve piston; as soon as the admissible speed of the turbine is exceeded by about 10 per cent, the governor releases the pressure of the oil-pressure system, whereby the main throttle valve H and a second "emergency" throttle valve Q inserted between the main stop valve G and the main throttle valve H are closed at once.

All these parts are arranged so as to open only when a full oil pressure exists, and it is impossible to start the turbine unless the oil system is under pressure. Hence before starting the turbine an auxiliary oil pump is employed to generate pressure in the oil system. This auxiliary pump is stopped as soon as the turbine is in normal action.

The Sulzer designs can be adapted for use as exhaust turbines, mixed-pressure turbines, tapped or bleeder turbines and back-pressure turbines. In the exhaust turbine the irregular supply of steam is equalized by heat accumulators between the reciprocating engine and the turbine. If the exhaust steam alone does not suffice, the mixed-pressure turbine is employed. This consists of two impulse wheels with a reaction drum behind them. Normally, only the second impulse wheel and the reaction drum are at work, but as soon as the exhaust steam falls short of a certain pressure live steam is automatically admitted to the first impulse wheel and expanded down to the pressure of the low-pressure steam and mixed in the second impulse wheel with the exhaust steam supplied from the reciprocating engine.

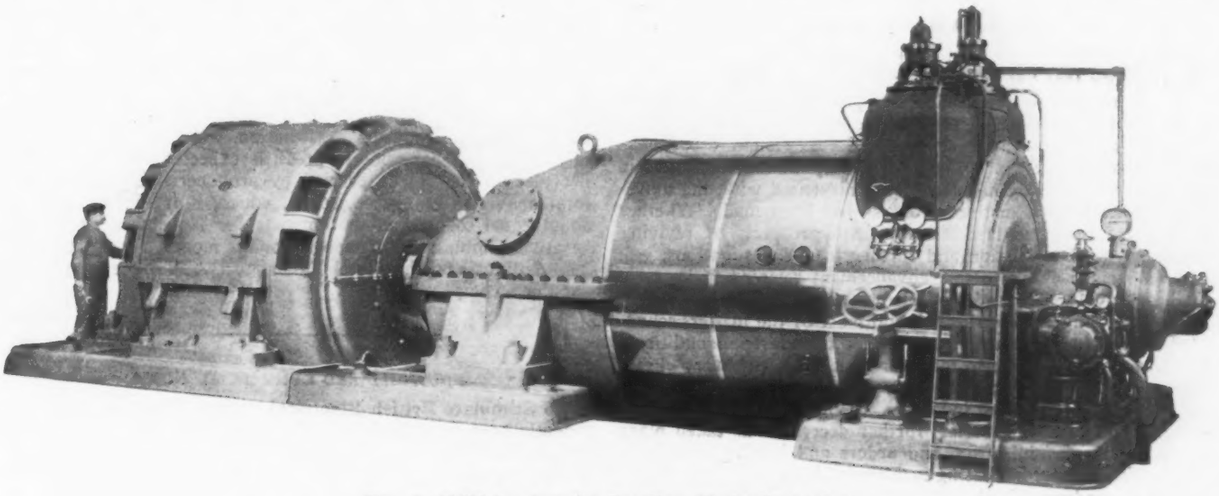


Fig. 1—10,000-hp Impulse-Reaction Turbo-Generator.

When some of the steam of the turbine at a stated pressure is required for other uses, say for boiling or heating, the turbine adapted is a tapped or "bleeder" turbine which is constructed like the mixed-pressure turbine. All of the steam is expanded in the first impulse wheel down to the pressure at which a supply of steam is to be tapped from the turbine and is then partly carried off by a supply pipe for other uses and partly passed on to the second impulse wheel, while the pressure at which the steam is tapped is maintained at a uniform level in case of varying loads by means of a mercurial governor. When all of the exhaust steam of the turbine is required for other purposes use is made of a back-pressure turbine, which resembles the ordinary steam turbine in construction except that it is of shorter over-all length. If the back pressure (or the pressure at which the steam is to be carried off) is sufficiently high, the reaction turbine portion may even be dispensed with entirely.

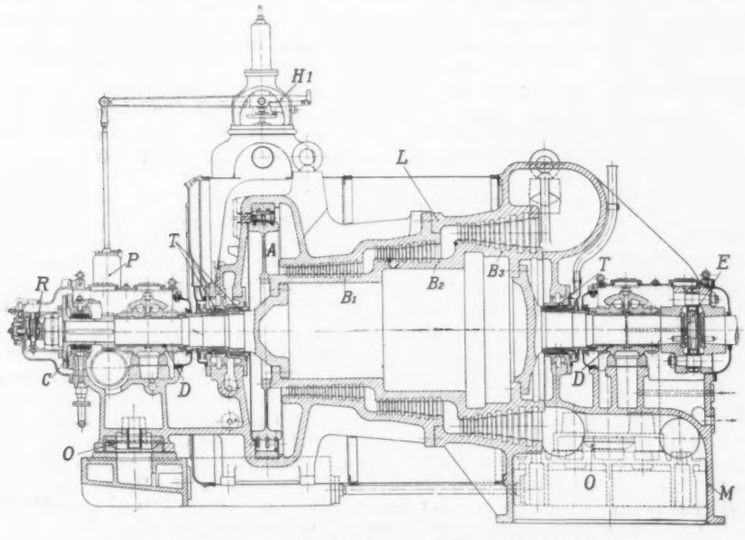


Fig. 2—Longitudinal Section of Turbo-Generator.

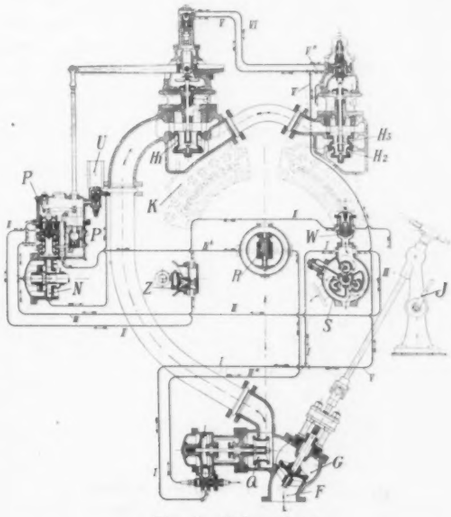


Fig. 3—Valve Gear.

Industrial and Commercial News

The Week in Trade.

CONTRASTING sharply with the conservative, day-to-day policy that has been followed for the greater part of the year, the growing tendency to place orders for the future is by far the most conspicuous development in the trade situation. Its appearance after several weeks of moderate optimism is most opportune, and though hesitancy and deliberation in commitments have by no means been dispensed with, the movement indicates that distinct progress has been made. Whether opening of Congress last Monday, with prospects of reviving excessive tariff legislation and further trust investigations, will offer a serious check to this advancement remains to be seen. At best, any further trade expansion will come slowly. A long session of Congress is expected, and most of the matters scheduled for consideration are closely related to industrial conditions. It is natural, therefore, to look for at least a temporary check. That confidence is well founded, however, is shown in the changes in the various industries of the country. Railroad earnings are becoming better, further decrease has taken place in the number of idle cars, and orders and inquiries for railroad equipment are increasing each week. A result of the latter has been an advance in the prices of steel bars by both the Steel Corporation and the independents. Jobbers and manufacturers are showing marked satisfaction over these signs of better prices in the steel trade, for while the volume of business has been increasing steadily, much of it has been written at rates too low for a good profit. Prices in the pig-iron market, on the other hand, have declined. Interest has been widely increased by these figures. Sales have been highly encouraging, and the immediate prospects for disposal of heavier tonnages are very good. Holiday trade has been good, and retail lines are reaping the benefit of cold weather. Mill operations in the Fall River district are enlarging, and improvement in the prices of cotton goods is reflected in the activity of trading in this field. Business failures for the week ended Nov. 30, as reported by *Bradstreet's*, were 216, as compared with 293 for the previous week, 217 for the corresponding week in 1910, 230 in 1909, 234 in 1908, and 272 in 1907.

The Copper Market.

WHILE the smaller agencies have been offering electrolytic at prices considerably lower than the 13⅛ cents to 13¼ cents per lb. quoted by the larger interests, few orders of consequence have been placed this week by either domestic or foreign consumers. With absence of selling pressure and halt in advancement of prices, the buying movement has practically subsided, and the market has again assumed that degree of quietness which prevailed in recent weeks. Operators with high costs of production regard with extreme disfavor the prospects of a decline which will again bring prices under the 13-cent level, for this figure, it is claimed, means the difference between profit and loss for them. A net decrease of 1,704,640 lb. in the visible supply of standard copper in Great Britain and France during the second half of November was shown in the last fortnightly statistics, which reduced the visible supply in these countries to 131,821,760 lb. on Dec. 1, the lowest figure reported since May, 1909, when the visible supply was placed at 127,353,000 lb. Conditions at this time do not indicate that early improvement will be made in the industry, excepting a possible increase in foreign buying. Standard copper in New York has been rather dull and easier, while practically no changes of importance have taken place in London. The November report of the Copper Producers' Association, which will be published after this issue has gone to press, is expected to show a small decrease in the stocks carried by producers. Estimates place total deliveries at 125,000,000 lb., which, it is thought, will be about equal to production. Imports for November were comparatively light, and the exports for the month were 26,431 tons. The daily call on the Metal Exchange Dec. 6 quoted copper as per the accompanying table.

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	12.60	12.85	.....
December	12.67½	12.80	12.75
January	12.70	12.85	12.77½
February	12.70	12.90	12.80
March	12.70	12.95	12.82½

The London market, Dec. 6, was as follows:

	Noon. £	s	d	Closing. £	s	d
Standard copper, spot	58	12	6	58	10	0
Standard copper, futures	59	6	3	59	5	0

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	12.95c	11.57½c
London, spot	£59 5 0	£53 7 6
London, futures	60 0 0	54 0 0
Best selected	63 10 0	57 5 0

Industrial and Commercial Notes.

To Stimulate British Electrical Export Trade.—There has recently been organized in London, under the name of Scholey & Company, Ltd., a new firm which will make a specialty of stimulating the export of British electrical manufacturers to the outlying foreign fields, thus resembling the Allied Machinery Company of America, recently organized to serve the interests of machine-tool makers. Mr. Scholey, the organizer of the firm, has had a long and successful career in the electrical business. For ten years he was assistant editor of *The Electrical Review*, of London, afterward gaining a few years' experience in electrical manufacturing and the selling of electrical goods in the employ of Mather & Platt, of Manchester. For the last ten years he has been intimately associated with the progressive firm of Dick, Kerr & Company, during which time he has made innumerable friends among the electrical men in Great Britain. For some years, however, Mr. Scholey has considered that sufficiently organized plans were not made for the disposition abroad of many British manufactures. Many millions of money are invested in Great Britain in the smaller companies manufacturing electrical goods. A large number of these companies have specialized in their manufactures and are thus in a position to make their own specialties much more cheaply and accurately than companies making a greater variety of materials. Such firms, however, are frequently so engrossed by their manufacturing that they have little time for the marketing of their goods outside their own local area and especially outside Great Britain. Mr. Scholey believes, therefore, that by creating a selling organization and by making special arrangements with a number of these specialists in electrical manufactures he will be able to supply the wants of foreign companies who may be desirous of getting the best British manufactured goods but who do not well know where or from whom to buy them. At the same time he will be benefiting these manufacturing companies by taking the expense and worry of selling off their shoulders. Scholey & Company have already entered into definite agreements with a number of firms manufacturing electrical specialties and in time they will add others to their list. Though the main feature of the business of Scholey & Company will be the developing of export trade, it is not intended to neglect the home markets, and as there is probably no one who knows personally a larger number of electrical men in Great Britain than Mr. Scholey this portion of the business will doubtless meet with immediate success. Mr. Scholey has taken into partnership with him C. W. Hill, who until within the last few weeks was the manager of the Bournemouth Tramways. Mr. Hill is well and favorably known to the electrical fraternity, and as Mr. Scholey and he have known each other for many years there is little doubt that their business associations will result successfully. The new company has taken commodious offices at 151 Queen Victoria Street, London, and has already done a considerable business. As quickly as opportunity occurs agencies will be opened up in this country and in the most prominent towns in the British colonies and South America.

Westinghouse, Church, Kerr & Company Contracts.—Westinghouse, Church, Kerr & Company are now engaged in the design and construction of numerous additions to the

present boiler plant of the Canadian Westinghouse Company, Ltd., at Hamilton, Ontario, Canada. The original boiler plant consisted of a building designed to house four 200-hp Stirling boilers, of which two are now installed together with auxiliary apparatus. The new building is to use as much of the old structure as possible and when completed will provide for four 400-hp Stirling boilers, one of which is to be installed at the present time. The two 200-hp boilers installed in the old building will be left in position for the present. The stack is to be made large enough to take care of an additional 400 hp, making a total capacity of 2000 hp. The equipment to be installed consists of the boilers mentioned above, stokers under both old and new boilers, a new 2000-hp concrete stack, boiler-feed water heaters, pumping equipment, piping and overhead coal bunker, and coal and ash handling apparatus, with other auxiliary equipment. Space will be left for a future 750-kw turbine and a 500-cu. ft. air compressor. The old plant is operating without interruption during the progress of the work of improvement. In addition to the work which these engineers are doing at Champaign, Ill., for the Illinois Central Railroad, mentioned in these columns Nov. 25, they are also engaged with other work for the same railroad at Burnside, Ill. This work includes overhauling of the Burnside power plant to increase its general efficiency and to eliminate the present shortage of steam, construction of a concrete chimney for the entire requirements of the plant with reasonable provision for its future growth, and remodeling the boiler house to permit economical handling of coal and ashes. The coal-handling system consists of a balance skip hoist elevating coal from the track hopper, dumping it automatically into an overhead bin of approximately 150 tons capacity, whence it is discharged as desired into a 5-ton hopper which travels in front of the stoker hoppers and discharges into them as required. The ash-handling equipment is operated pneumatically. This work also includes overhauling the piping to give a modern loop system and permit installation of a new and sufficient feed-water heater and pumps, installation of two 600-kw exhaust steam turbines and generators for the generation of alternating current, the generators being excited by two 25-kw exciters, purchase and installation of the necessary alternating-current motors to change from the present steam drive to motor drive, installation of a cooling tower, complete electric feeder system for power and yard lighting including the overhauling of the present direct-current feeder system, and construction of an engine-room to house the turbines mentioned above. Orders have been placed for all equipment required for the foregoing changes.

Constantinople Telephone Company.—A company of this name has been organized to take over a concession for establishing a telephone system embracing the city of Constantinople, Turkey, and all of the suburban places on the European and Asiatic shores of the Bosphorus and the Sea of Marmora, comprising a population of 1,250,000. This will be the first general telephone system installed in Turkey. The capital is £300,000 in shares of £5 each, and the initial installation will be 10,000 stations. The concession was negotiated by Herbert Louis Webb, who is one of the directors of the company, other directors known in electrical circles in this country being F. R. Welles, vice-president of the French Western Electric Company, and Ernest Thurnauer, general manager of the French Thomson-Houston Company. The concession is an outcome of the progressive policy pursued by the modernized Turkish government, under which liberal institutions are being established and commercial development encouraged.

Electrical Lock-Gate Operation on Chicago Drainage Canal.—At a recent meeting of the Board of Trustees of the Sanitary District of Chicago bids were received for furnishing and erecting electrical operating machinery for gates on the navigation lock adjacent to the hydroelectric power house on the Chicago Drainage Canal near Lockport, Ill. The bids were submitted in two parts, one for the equipment of the main lower gate and the other for the equipment of the main upper gate. The lowest bidder for the two was the Klemp-Simpson Company, of Chicago, the amount being $4,140. Other bidders were George P. Nichols & Company, the National Contracting Company and the Strobel Steel Construction Company.

"Nela" Buildings of National Electric Lamp Association.—Ground has been broken for the new buildings composing the "Nela" group of the National Electric Lamp Association, 12 miles east of the city of Cleveland, overlooking Lake Erie. A commodious building will be erected to house the engineering laboratory, which will be removed from its present Hough Avenue location, while other special structures will be provided for the physical laboratory, lamp-development department, the general library, etc. In all a dozen buildings will be erected on the spacious campus, which commands a rare view of woodland ravine and lake. Nearly a million dollars is to be expended at Nela, it is said, and the first buildings will be ready for occupancy within a year.

November Incorporations.—Compilation by the *Journal of Commerce*, New York, shows that papers filed in the Eastern States during November for companies with an authorized capital of $1,000,000 or over, including increases in capital, represent a total of $150,593,400, an increase of $26,373,400 over October, and $31,570,400 as compared with November, 1910. Charters taken out by other companies with an individual capital of $100,000 or over, including states other than those in the East, increased the month's total to $362,158,400, which compares with $187,178,500 in October and $183,388,000 in November last year.

Westinghouse Company Enlarging East Pittsburgh Plant.—Two large additions are being made to the plant of the Westinghouse Electric & Manufacturing Company at East Pittsburgh, Pa. One of these additions will be used for the manufacture of electrical equipment, and the other, a modern fireproof building, will be used for the manufacture of packing boxes.

Wants Bids on Generators and Oil Engines.—The Groton Light, Heat & Power Company, of Groton, S. D., is in the market for one or more 40-kw, 220-volt, direct-current generators and crude-oil engines to drive same. Correspondence may be addressed to H. A. Raitz, general manager.

Financial.

THE WEEK IN WALL STREET.

DECIDED apathy prevailed upon the New York Stock Exchange during the first half of this week. Lack of stimulus or motive seemed to be the chief cause of this condition, although desire to wait upon the President's message was offered rather generally on Monday as an excuse for the inactivity of the day. Price changes on Monday were insignificant, and the volume of trading was very curtailed as compared with the daily average in recent weeks. The only items of general news in which the financial district displayed any interest were the opening of Congress and the filing of a petition by the independent tobacco companies seeking review by the Supreme Court of the plan for reorganiza-

NEW YORK.

	Nov. 28.	Dec. 6.	Shares Sold.		Nov. 28.	Dec. 6.	Shares Sold.
All. Ch.....	3¼*	2½	300	Int. Met., pf.	47	46⅝	11,300
All. Ch., pf..	13¼*	9	200	Mackay, Cos.	83	83*	———
Amal. Cop...	64	61⅛	60,150	Mackay C.,pf.	72½	72⅜	53
Am. D. T...	33⅛*	33⅛*	———	Man. Elev..	134	135*	100
Am. Loco...	36	35	1,000	Met. St. Ry.	15*	15*	———
Am. Loco.,pf.	102⅞	102⅝	250	N.Y.&N.J.Tel.	139½*	139½*	———
Am. Tel. & C.	78*	78*	———	Steel, com...	64⅛	62⅜	552,950
Am. T. & T..	139⅛	139	22,050	Steel, pfd....	109¼	109¼	3,800
B. R. T.....	77¾	77	6,210	W. U. T....	77½	78⅛	1,400
Gen. Elec....	154½	152¼	2,200	West'h, com.	65	65*	1,900
Int. Met....	15	14¾	12,272	West'h, pfd..	113	113*	———

PHILADELPHIA.

	Nov. 28.	Dec. 6.		Nov. 28.	Dec. 6.
Am. Rys.....	46¼	46	Phila. R. T.....	23¾	23¼*
El. Co. of A.....	12	11⅞*	Phila. Elec.....	16	16
Elec. St. Bt'y.....	53½	54	Phila. Trac.....	84½	84⅞
Elec. St. Bt'y., pf..	30*	30*	Union Trac.....	52⅛	52¼

CHICAGO.

	Nov. 28.	Dec. 6.		Nov. 28.	Dec. 6.
Chi. City Ry.....	186*	186*	Com. Edison.....	134½	133½
Chi. Elev. Rys.....	30*	29*	Chi. Subway.....	½	⅜*
Chi. Elev. Rys., pf..	94*	94*	Chi. Telephone....	139¼	138¾
Chi. Rs., Ser. 1....	95*	95*	Nat'l Car.....	105*	104*
Chi. Rs., Ser. 2....	33½	34⅞	Nat'l Car, pfd.....	118*	118*

BOSTON.

	Nov. 28.	Dec. 6.		Nov. 28.	Dec 6.
Am. T. & T.....	140¼	139	Mex. Tel.....	3*	3¼*
Cum. Tel.....	156½	157	Mex. Tel., pf.....	6½*	6½*
Edison	287	290	N. E. Tel.....	150	154
Gen. Elec.....	155	153	W. T. & T.....	27½*	27½*
Mass. E. Ry.....	21½	22	W. T. & T., pf.....	104¼*	104¼*
Mass. E. Ry., pf....	94	93			

*Last price quoted.
Shares sold for the week, Nov. 27 to Dec. 2.

tion of the American Tobacco Company. Transactions in bonds were more animated than those in stocks. No changes in the stagnation appeared in Tuesday's market as a result of publication of the President's message. The message did not contain any special additions to the President's previous remarks upon trust questions. That Presidential approval was given in the message to the decision of the Circuit Court upon the American Tobacco Company's reorganization plan was taken as an indication that reopening of the case upon independent petition is rather unlikely. Further weakness developed in the trading on Wednesday, and a downward tendency was in evidence throughout the day. Mild activity took place toward the close, and negligible declines were made. Allis-Chalmers issues declined slightly in the course of the day's transactions, strengthening the belief that reorganization of the company is imminent. Call money, after a rise to 6 per cent toward the close of last week, was quoted at about 5 per cent in the first three days of this week, but ease is predicted to occur within a short time. Rates Dec. 6 were: Call, 4½ @ 5 per cent; ninety days, 4 @ 4¼ per cent. The quotations in the table are those at the close, Dec. 6.

Financial Notes.

Statement of the Washington, Baltimore & Annapolis Electric Railroad Company.—The Washington, Baltimore & Annapolis Electric Railroad Company has issued its report of earnings for the month of October and for seven months of the new fiscal year. The total gross operating revenue of the road for the month was $61,860.47, as compared with $64,802.71 in October last year, a decrease of $2,942.24. Operating expenses were $30,650.60, as against $31,330.52, a decrease of $679.92, and net operating revenue was $31,209.87, as compared with $33,472.19 for October, 1910, a decrease of $2,262.32. Deductions from income, including interest on bonds, taxes, etc., amounted to $22,083.81, as compared with $30,927.06, a decrease of $8,843.25, making the final net income $9,391.93, as against $3,230.88, a gain of $6,181.05 over this item in October, 1910. The falling off in business during October, it is pointed out, was due to the conflicting racing dates at Pimlico and Laurel, which affected the attendance at the local track. Last year 3729 passengers were carried by the company during the meet at Pimlico, the revenue from that traffic being $4,288.33. This year only 593 persons were carried during the races. This year the revenue amounted to $671.95, or a loss of $3,617. The gross operating revenue for the seven months ended October 31 totaled $438,988.98, as compared with $434,256.59 for the corresponding period last year, or an increase of $4,732.39. Operating expenses for the period were $205,361.44, as against $207,897.57 for 1910, or a decrease of $2,563.13. Net operating revenue for the seven months was $233,627.54, as contrasted with $226,359.02 for 1910, an increase of $7,268.52. Final net income, after deducting fixed charges, taxes, etc., amounted to $79,417.03, as against $10,974.26, a gain of $68,442.74. The percentage of operating expenses to gross operating revenue was 46.78 per cent, as against 47.87 per cent for the corresponding seven months of 1910.

Hall Signal Company Reorganization Plan.—The committee which, as previously mentioned in these columns, has been working for some time upon reorganization of the affairs of the Hall Signal Company, has formulated a plan for accomplishing its purpose, and it is expected that announcement of details will be made within a short time. The Hall Signal Company is a three-million-dollar corporation engaged in the manufacture and installation of automatic railway signals. Edward P. Goetz, secretary of the readjustment committee, says: "The sum of $100,000 has been raised with which to place the affairs of the company on a sound footing. Many overdue accounts were paid off with this money and funds were provided to purchase new supplies and materials. The company now has contracts and orders on hand aggregating $450,000, and its business prospects are very good." More orders are on hand at present than at any time since the summer of 1909. The plants of the company are operated on extra night shift three times per week.

Kansas City Railway & Light Statement.—The consolidated balance sheet of the Kansas City Railway & Light Company as of May 31, 1911, shows as follows:—Assets: Cost of properties, $51,055,530; special, $5,100; material and supplies, $338,060; miscellaneous investment, $75,190; accounts receivable, $264,489; accrued earnings, lighting companies, $54,084; bills receivable, $19,473; cash, $138,393; cash for coupons, $153,050; bonds expired, etc., $360,854; prepaid interest, etc., $32,510; total, $52,496,733. Liabilities: Preferred stock, $9,407,500; common stock, $9,543,080; stock of subsidiary companies, $72,350; bonded debt, $28,526,000; equipment notes, $120,000; bills payable, $984,382; maturing bonds, $5,100; miscellaneous accounts, $411,895; accrued taxes, $374,926; accrued interest, $217,898; coupons due, $153,050; depreciation and renewal reserve, $1,645,859; surplus, $1,034,693; total, $52,496,733.

La Crosse Water Power Company Reorganization.—C. C. Smith, receiver for the La Crosse Water Power Company, of La Crosse, Wis., has ordered the offices of the company closed and announcement has been made, it is said, that repairs at the dam cannot be completed until next spring. Efforts to cash receivership certificates to repair the damage are said to have failed and a 5 per cent assessment has been made against bondholders to raise the required money. The reorganization of the company that has been in progress for some months may be effected during the course of the winter.

Safety Car Heating & Lighting Company Increases Dividend.—An extra dividend of 1 per cent on the capital stock has been declared by the Safety Car Heating & Lighting Company, in addition to the regular quarterly dividend of 2 per cent. This raises the total dividend for the year to 9 per cent. An extra dividend of 3 per cent was paid at this time last year. The dividends are payable Dec. 22 to holders of record December 8.

Great Western Power May Merge with Pacific Gas & Electric.—Rumors of a mutualization plan to be effected between the Great Western Power Company and the Pacific Gas & Electric Company are rather general in financial circles, but interests in touch with these companies are not disposed to discuss the matter at present.

Ohio Company Will Issue $500,000 Stocks and Bonds.—The Springfield & Washington Electric Railway Company of Springfield, Ohio, has received permission from the Ohio Public Service Commission to issue $500,000 stocks and bonds. The company plans to issue $200,000 stock and $300,000 thirty-year bonds to be sold at not less than 85.

New Canadian Company Formed.—Advices from Toronto state that the Northern Ontario Light & Power Company, Ltd., has been formed to take over the properties of the Cobalt Power Company, Ltd., and those of the Cobalt Hydraulic Power Company, Ltd.

Dividends

Canadian General Electric Company, Ltd., quarterly, 1¾ per cent, payable Dec. 30.

Mackay Companies, quarterly, preferred, 1 per cent, common, 1¼ per cent., both payable Jan. 2.

Massachusetts Electric Companies, preferred, $2 per share, payable Jan. 2.

Sao Paulo Tramway, Light & Power Company, Ltd., quarterly, 2½ per cent, payable Jan. 2.

Standard Gas & Electric Company of Chicago, quarterly, preferred, 2 per cent, payable Dec. 15.

United Railways & Electric Company of Baltimore, semi-annual, preferred, 2 per cent, payable on demand.

West Pennsylvania Traction Company, quarterly, 1 per cent, payable Dec. 15.

Report of Earnings.

BOSTON SUBURBAN ELECTRIC COMPANIES.

Period		Gross Earnings.	Operating Expenses.	Net Earnings.	Fixed Charges.	Net Surplus.
October,	1911.....	$71,381	$53,793	$17,588	$14,246	$3,342
October,	1910.....	70,821	49,392	21,429	14,147	7,282

FAIRMONT & CLARKSBURG TRACTION COMPANY.

October,	1911.....	$67,969	$25,598	$42,371	.....	.....
October,	1910.....	58,504	19,386	39,118	.....	.....

MEXICAN LIGHT & POWER COMPANY, LTD.

October,	1911.....	$627,949	$135,247	$492,702	.....	.....
October,	1910.....	599,172	147,757	451,415	.....	.....

MEXICO TRAMWAYS COMPANY.

October,	1911.....	$543,751	$266,326	$277,425	.....	.....
October,	1910.....	527,603	259,835	267,768	.....	.....

RIO DE JANEIRO TRAMWAY, LIGHT & POWER COMPANY, LTD.

October,	1911.....	$1,126,972	$526,358	$600,614	.....	.....
October,	1910.....	965,265	470,845	494,420	.....	.....

UNITED RAILWAYS COMPANY OF ST. LOUIS.

October,	1911.....	$1,051,472	$663,540	$387,932	.....	.....
October,	1910.....	1,041,838	685,685	356,153	.....	.....

General News

Construction News.

VALDEZ, ALASKA.—The Alaska Water, Light & Telephone Company is planning the erection of an electric-power plant in the Sulphide Gulch district.

PHOENIX, ARIZ.—The Board of Supervisors has granted the Tracy Engineering Company a franchise to erect and maintain a transmission system from the Colorado River to Kingman and vicinity. The company is planning to build a large hydroelectric power plant on the Colorado River.

TUCSON, ARIZ.—Plans are being considered by the Powmott Development Company for the erection of a hydroelectric power plant, near Silverton. A transmission line will be erected from the plant to the company's mining properties, a distance of 15 miles.

PARAGOULD, ARK.—The Paragould Electric Light & Power Company, it is reported, is planning to make extensive additions to its plant, which will involve an expenditure of $15,000 and include the erection of an addition to its power house and the installation of a generator and a new engine.

ALLEGHENY, CAL.—Plans are being considered for the erection of a power plant at the Twenty-one Mine, operated by F. M. Phelps, in the near future.

BAKERSFIELD, CAL.—The Southern Sierra Power Company has filed notice of its intention of filing articles of incorporation in the State of California for the purpose of erecting power plants and transmission lines to supply electricity for lamps and motors in the southern San Joaquin Valley counties. The company is capitalized at $5,000,000, and is at present operating in Colorado and Wyoming. Delos A. Chappell, Lawrence C. Phipps, Jr., C. F. Potter, T. S. Hayden and G. Wood compose the directorate.

BAKERSFIELD, CAL.—The Board of Trustees has granted the San Joaquin Light & Power Company an electric railway franchise for a term of forty-nine years on North Chester Avenue, for a consideration of $250. Under the terms of the franchise the company is to pay the city 2 per cent of its gross earnings.

BERKELEY, CAL.—The Berkeley Electric Lighting Company, which is controlled by the Pacific Gas & Electric Corporation, has notified Mayor J. Stitt Wilson of a reduction in the price of electricity for lamps in Berkeley. A recent ordinance put the maximum rate of electricity at 8½ cents per kw-hour, which the company now voluntarily reduces to 7 cents per kw-hour.

BERKELEY, CAL.—The City Council has asked Mayor J. Stitt Wilson to secure data on and other information pertaining to the cost of the installation and maintenance of municipal lighting plants which are now in operation throughout the country. The Mayor recently recommended in a message that the city establish a municipal plant.

CONCORD, CAL.—The Mount Diablo Telephone Company, recently incorporated, is planning to erect a telephone line from Concord to Clayton and the Ignacio Valley, a distance of about 25 miles. H. C. Wetmore, of Concord, is president.

CRESCENT CITY, CAL.—Plans for the construction of a hydroelectric power plant on the Smith River, near Crescent City, it is reported, are being prepared by James H. Owen, with a transmission system throughout the surrounding territory. Sidney Sprout, of San Francisco, Cal., electrical engineer, is in charge of the work.

ELK GROVE, CAL.—The Pacific Gas & Electric Company, it is reported, contemplates the installation of a street-lighting system in Elk Grove. Incandescent circuits will be installed.

FRESNO, CAL.—The San Joaquin Light & Power Company is reported to have awarded the contract for the construction of its large power plant and dam, to be located at Big Creek, near Fresno, to the Stone & Webster Engineering Corporation, Boston, Mass.

GLENDALE, CAL.—Arrangements have been made whereby the system of the Glendale Light & Power Company in West Glendale will be taken over by the city, for a consideration of $55,000, and operated in connection with the municipal electric-lighting system. Bonds to this amount will be issued by the city. The system will be enlarged and improved, and new distributing lines erected. The amended plans for the ornamental street-lighting system to be erected on Fourth Street, from Everett Street to Central Avenue, on Brand Boulevard, from Third to Sixth Street, and on Glendale Avenue, from First to Sixth Street, call for 140 lamp standards, carrying five lamps each, to be placed 150 ft. apart.

LOS ANGELES, CAL.—Bids will be received by the finance committee of the City Council until Feb. 15 for the purchase of $3,500,000 power bonds and $3,000,000 harbor bonds. The bonds will be disposed of in one lot or delivered in several lots at different times, at the option of the purchaser.

LOS ANGELES, CAL.—The stockholders of the Pacific Electric Railway Company have ratified a bond issue of $100,000,000 for the purpose of providing for the underlying bonds of the various subsidiary companies and for extensive additions to its system. Paul Shoup is vice-president and general manager.

LOS ANGELES, CAL.—The contract for the installation of ornamental electric fixtures and electrical work on the ornamental fence to be erected around the County Hospital grounds has been awarded to the Woodill-Hulse Electric Company, at $2,894.

MARTINEZ, CAL.—The Town Trustees have decided to install tungsten lamps for lighting the streets of the city, for which a contract has been awarded to the Pacific Gas & Electric Company. Work will begin at once on the installation of the new system.

NORTH SAN JUAN, CAL.—Plans are being considered by the Northern Water & Power Company for the construction of a large dam, capable of holding more than 500,000 inches of water. The dam will be located near North San Juan, on the Ray, Phelan and adjoining ranches.

OAKLAND, CAL.—The Oakland Gas, Light & Heat Company has announced reduction in the price of electricity for lamps to take effect from Dec. 1. Under the new schedule the maximum rate will be 7 cents per kw-hour with a sliding scale of 3 cents per kw-hour. The present rate is from 9 cents to 3½ cents per kw-hour. The company is controlled by the Pacific Gas & Electric Corporation. The reduction was voluntary on the part of the company.

PASADENA, CAL.—The City Council has authorized the municipal lighting commission to make improvements to the municipal electric-light system, including the building of conduits, line extensions and new equipment, involving an expenditure of $21,000.

PATTON, CAL.—Bids will be received at the office of the state engineer, Sacramento, Cal., until Dec. 16, for the construction of a power house to be erected on the grounds of the Southern California State Hospital in Patton.

PLACERVILLE, CAL.—Sealed proposals will be received by T. C. Atwood, county clerk, until Jan. 3, 1912, for the construction and installation of electric-lighting fixtures for all outlets in the court house in Placerville and outside standards at the entrance of same. Plans and specifications are on file at the office of Cuff & Diggs, architects, Sacramento, Cal., and at the office of the county clerk.

RIO VISTA, CAL.—The Pacific Gas & Electric Company is planning to replace the arc lamps now in use with tungsten lamps. It is proposed to install sixty tungsten lamps throughout the city. At present there are fourteen arc lamps and eight incandescent lamps.

SACRAMENTO, CAL.—Contracts have been awarded by the Pacific Gas & Electric Company for the erection of its new steam auxiliary power plant in Sacramento, as follows: To the Rickon-Ehrhart Engineering & Construction Company, of San Francisco, Cal., for structural steel work, at $48,500; Forderer Cornice Works, of San Francisco, Cal., $4,200, and the Ross Construction Company, of Sacramento, Cal., $4,417. The plant will have a generating capacity of 12,500 kw.

SAN FRANCISCO, CAL.—The Vermont Marble Company has petitioned the Board of State Harbor Commissioners to install a large electric crane, with capacity to handle large blocks of marble, on one of the local docks.

SAN JOSE, CAL.—Preparations are being made by the Sierra & San Francisco Power Company to supply electricity in San José. The company has two transmission lines running from its plant on the Tuolumne, one of which passes within 9 miles of this city. This county will be supplied from the substation near Alviso.

SANTA CLARA, CAL.—Plans are being considered by D. O. Druffield, of Santa Clara, for the erection of an electric power plant to supply electricity to operate the mills of the Pacific Manufacturing Company in Santa Clara.

STANFORD UNIVERSITY, CAL.—The Board of Trustees of the Leland Stanford, Junior, University has awarded the contract for the erection of a power plant on the college campus to Frank M. Gardiner & Company, of San Francisco, Cal.

STOCKTON, CAL.—The Sierra & San Francisco Company expects to have its system in operation in Stockton very soon. The company has its main line from the power plant within 4 miles of the city and the poles have reached the city limits.

TULARE, CAL.—The Tulare County Power Company has awarded the contract for the construction of a power house for its new auxiliary power plant to Oscar Parlier, for $10,000. The cost of the plant complete is estimated at $250,000.

VISALIA, CAL.—Plans are being considered for the installation of a new street-lighting system in Visalia. The Mount Whitney Power Company furnishes the street-lighting service in this city.

WATSONVILLE, CAL.—Specifications are being prepared for electroliers for Main Street for the Commercial League. As soon as plans are accepted bids will be asked for installation of same.

BOULDER, COL.—Estimates are being prepared by H. S. Evans, of the engineering department of the State University, and Fred Dungan, city engineer, for the construction of a municipal electric-light plant. The city now pays more than $9,000 per year for lighting the city.

DENVER, COL.—The Larimer Street Improvement Association is contemplating the installation of ornamental street lamps along several blocks in the business section of Larimer Street.

WILLIMANTIC, CONN.—The Board of Aldermen has adopted a resolution providing for a committee to enter into a three-year contract with the Willimantic Gas & Electric Light Company for lighting the city. The present contract expires in January, 1912. Under the present contract the city pays $92 each per year for arc lamps.

WASHINGTON, D. C.—Sealed proposals will be received by the Commissioner of Indian Affairs, at the Office of Indian Affairs, Department of the Interior, Washington, D. C., until Dec. 29, for construction of a brick dormitory and a central steam-heating and power plant for the Rapid City Indian School, South Dakota, in accordance with plans and specifications which may be examined at the above office, the offices of the supervisor of construction, Denver, Col.; the United States Indian Warehouses, Chicago, Ill., and Omaha, Neb.; the Builders and Traders' Exchange, St. Paul, Minn., and at the school. Further information may be obtained on application to the superintendent of the Rapid City Indian School, Rapid City, S. D. C. F. Hauke is acting commissioner.

WASHINGTON, D. C.—Sealed proposals will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Dec. 27 for furnishing and installing lighting fixtures in the United States buildings at Ames, Ia.; Barre, Vt.; Canandaigua, N. Y.; Carbondale, Pa.; Faribault, Minn.; Holdrege, Neb.; Hope, Ark.; Independence, Kan.; Ionia, Mich.; Lagrange, Ga.; Lewiston, Idaho; Lexington, Mo.; Malone, N. Y.; McKinney, Tex.; Missoula, Mont.; North Yakima, Wash.; Pontiac, Mich.; Stevens Point, Wis.; York, Pa.; Bowling Green, Ky.; North Platte, Neb.; Roswell, N. M.; San Juan, P. R.; Richmond, Va., and Bath, Maine, in accordance with plans and specifications, copies of which may be obtained at the above office. James Knox Taylor is supervising architect.

BROOKSVILLE, FLA.—The citizens have voted to grant a franchise to J. T. Fuller, of Umatilla, Fla., to construct and operate an electric-light plant in Brooksville.

AUGUSTA, GA.—Announcement has been made that J. G. White & Company, of New York, N. Y., and Redmond & Company, bankers, have secured the controlling interest in the Georgia-Carolina Power Company. It is stated that work will soon begin on the construction of a new power dam at Stevens Creek, which, it is estimated, will develop a minimum of 12,000 hp. The dam will be located at the mouth of the creek, about a mile above the city locks.

COMER, GA.—The City Council has granted the Comer Light & Power Company a franchise to construct and operate an electric-light plant in Comer. Surveys have been made of the Comer mill property, and it is claimed that power can be developed to generate sufficient electricity to supply Comer and surrounding country.

DUBLIN, GA.—The Dublin Chamber of Commerce, it is reported, is considering taking up the matter of erecting a transmission line from the power plant of the Central Georgia Power Company, of Macon, Ga., which is located at Jackson, to this city, a distance of 60 miles. For several years the municipal electric plant has supplied electricity for nearly all the factories in the city.

TIFTON, GA.—Preparations are being made by the Tifton Ice & Power Company for enlarging its plant in this city, which will involve an expenditure of about $20,000. It is proposed to duplicate the machinery in the electric plant, and the ice plant will be enlarged to increase it to four times its present capacity.

WASHINGTON, GA.—Sealed proposals will be received until Dec. 20 by Boyce Ficklen, Jr., for construction of a new power plant, additions to the present water-works system and overhauling and extending the present electric-light and power transmission system in the city of Washington, in accordance with plans and specifications prepared by Westinghouse, Church, Kerr & Company, engineers. Copies of plans and specifications may be obtained from the city clerk upon deposit of $50, which will be refunded upon return of same. The specifications are divided into two parts, main and supplementary, and bids are desired as follows: (a) To furnish all material and do all construction by plans and specifications, this bid to be divided into two parts, one to cover the main specifications and the other the supplementary specifications; (b) this bid to cover construction of the building and foundations called for, but not to include the installation of machinery or construction of transmission lines; (c) this bid to cover the installation of all machinery and the construction of all transmission lines as called for in the plans and specifications, but not to include the construction of building and foundations for machinery, this bid to have separate bids called for under the main and supplementary part of the specifications.

NAMPA, IDAHO.—Preparations are being made by C. W. Van Kirk and J. J. Portner for the construction of an electric railway from Nampa to Caldwell, which will involve an expenditure of about $80,000.

ALTON, ILL.—The Board of Trade is considering the installation of an ornamental street-lighting system in the business district of the city.

ATHENS, ILL.—The City Council has awarded a contract to C. W. Carr, owner of the local electric-light plant, to light the streets of the city for a period of two years, at a cost of $1,728. An all-night service will be furnished.

CABERY, ILL.—It is reported that a stock company, composed of local business men, has purchased the Cabery telephone system, owned by N. A. Watts.

CARLYLE, ILL.—The capital stock of the Citizens' Telephone & Telegraph Company of Clinton County has been increased from $15,000 to $35,000.

CLINTON, ILL.—The City Council has granted the People's Telephone Company, of Chillicothe, Ill., a franchise to construct and operate a telephone system in Clinton for a term of twenty-five years.

LA SALLE, ILL.—The City Council, it is said, has decided to advertise for bids on 122 arc lamps and two Rush generators of sufficient output to provide for seventy-five lamps each.

MINOOKA, ILL.—The installation of an electric street-lighting system in Minooka is reported to be under consideration. It is understood that an electric-light company will apply to the Village Board for a franchise to supply electricity for lighting the streets and residences in the village.

QUINCY, ILL.—The Quincy Merchants' Lighting Association has awarded a contract for the installation of sixteen ornamental lamp standards around Washington Park, to cost $1,600.

SPRINGFIELD, ILL.—The Park and Pleasure Driveway Board is reported to have decided to purchase the ornamental lighting system on Fourth Street Boulevard from the Springfield Light, Heat & Power Company, at a cost of $16,800. The question of replacing Welsbach lamps on South Grand Boulevard with tungsten cluster lamps, at a cost of approximately $7,773, is under consideration.

STEWARDSON, ILL.—The question of establishing an electric-light plant in Stewardson is reported to be under consideration by the Village Board.

ALEXANDRIA, IND.—The Central Indiana Lighting Company has applied to the Council for a fifty-year franchise in Alexandria. The company wishes to secure the franchise before closing a deal by which it will take over the property of the Alexandria Electric Light & Power Company. The new company proposes to abolish the flat-rate system and supply electricity at 10 cents per kw-hour with a reduction of 5 per cent for prompt payment. It also asks for the privilege of making a minimum charge of $1 per month. W. E. Hitchcock, of Muncie, Ind., is representative of the company.

ANDERSON, IND.—Bids will be received by the Board of Public Works until Jan. 2 for the installation of a new turbine engine at the municipal electric plant. The cost of the new machine is estimated at about $30,000.

HARTFORD CITY, IND.—The United Telephone Company is planning to make extensive improvements to its rural telephone service in Harrison and adjoining townships. New lines will be erected and a modern lock-out system established. The present party-line system will be abolished.

JASONVILLE, IND.—The directors of the New Home Telephone Company have decided to make improvements to its local system, involving an expenditure of about $5,000. All wires will be placed in cables, a new switchboard will be installed and new poles erected.

JENNINGS, IND.—A twenty-five-year franchise has been granted to C. Johnson to operate an electric plant in Jennings. A contract was also awarded to light the streets of the town. The plant also will supply electricity for motors.

NEW CASTLE, IND.—The Central Union Telephone Company has purchased the property and the franchises of the New Castle Independent Telephone Company for a consideration of $25,000. The Central Union Company has taken an option on a site on which it proposes to build a new exchange at a cost of about $150,000.

ONTARIO, IND.—Plans are being prepared by the Pigeon River Milling Company for the construction of a hydroelectric power plant to supply electricity for lamps and motors in Ontario, Lagrange and Rome. The work will include the construction of a power house and improvements to a 600-ft. concrete dam.

ALTOONA, IA.—At an election to be held Dec. 16 the proposition to grant a light franchise to G. T. Gibson, of Des Moines, Ia., will be submitted to a vote.

AMES, IA.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., for installing lighting fixtures in the United States public building at Ames, Ia. James Knox Taylor is supervising architect.

BAYARD, IA.—The question of installing an electric-light plant in Bayard is reported to be under consideration.

BLANCHARD, IA.—A. L. Johnson, it is reported, is contemplating the installation of an ice plant in connection with an electric-light plant.

BRADDYVILLE, IA.—The installation of a new lighting plant in Braddyville is reported to be under consideration.

BRIGHTON, IA.—The contract for the construction of the power dam has been awarded to L. J. Highland.

DENVER, IA.—The proposition to grant an electric-light franchise in Denver will be submitted to a vote at an election to be held Dec. 11.

FORT DODGE, IA.—The Northern Iowa Power Company is planning

to construct a hydroelectric power plant north of this city. The company is capitalized at $500,000 and proposes to install a plant with an output of 2000 hp. The cost of the plant is estimated at $240,000.

GALVA, IA.—At an election held Nov. 21 the citizens voted to issue bonds to the amount of $8,500 for the installation of an electric-light plant in Galva.

GEORGE, IA.—The installation of an electric-light plant in George is reported to be under consideration.

GREENE, IA.—A petition is being circulated in Greene to grant Claud Mackey, of Waverly, Ia., a franchise to supply electricity to light the town.

HAMPTON, IA.—The Hampton Electric Light & Power Company has been awarded judgment for $8,000 damages against the Iowa Central Railroad Company for the loss caused when its plant was destroyed by fire last summer. It was charged that the fire was caused by a spark from a locomotive owned by the railroad company.

HOPKINTON, IA.—Investigations are being made with a view of building a dam on the Maquoketa River. If sufficient power can be developed a new electric-light plant may be installed.

KAMRAR, IA.—The local business men are considering the question of installing a street-lighting system in Kamrar.

KEOKUK, IA.—Work has been commenced on the survey for the proposed transmission line from Keokuk to Burlington by the Stone & Webster Engineering Corporation. The cost of the line is estimated at about $600,000.

MANCHESTER, IA.—The Manchester Light, Heat & Power Company is reported to have been awarded the contract for street lighting for a period of five years.

MOUNT PLEASANT, IA.—The City Council has authorized the city clerk to advertise for bids for the proposed alterations to the municipal electric-light and water plant.

PERRY, IA.—The proposition to grant a light franchise was defeated at a special election held recently.

PIERSON, IA.—A movement is reported to be on foot to install an electric-light plant in Pierson.

STEAMBOAT ROCK, IA.—At an election held recently the proposition to grant the Park Dam Company, of Eldora, Ia., a franchise to supply electricity for lamps in Steamboat Rock was carried.

HUTCHINSON, KAN.—It is reported that plans are under way for the formation of a corporation with a large capitalization for the purpose of supplying the entire Arkansas Valley with electricity for lamps and motors. The project also includes an electric interurban railway extending up the Arkansas Valley from Hutchinson to Garden City and also to supply electrical energy for pumping water from the underflow for irrigation purposes. It is said that men closely connected with large electrical manufacturing interests are interested in the project.

LAWRENCE, KAN.—The County Commissioners have rejected all bids submitted for furnishing machinery for the electric-lighting and water-pumping plant at the new county hospital, as all the bids were considered too high. The county clerk has been authorized to call for new bids.

MINNEAPOLIS, KAN.—The City Council is considering the question of purchasing the electric-light plant of the Jackman Roller Mills. The city last June voted to issue bonds for the installation of a municipal electric-light plant. Before purchasing the plant the proposition will have to be submitted to a vote of the people.

WICHITA, KAN.—The City Commissioners have decided to call a special election, to be held Dec. 12, to vote on the propositions for establishing municipal water-works, a municipal lighting system and other improvements.

CADIZ, KY.—Alexander Brothers are reported to have been granted an electric-light franchise in Cadiz.

CAMPBELLSVILLE, KY.—The Campbellsville-Taylor Company is reported to be contemplating the construction of an electric-light plant to replace the one recently destroyed by fire. The cost of the proposed plant is estimated at about $30,000.

NEW ORLEANS, LA.—The Louisiana Southern Railroad, which is now owned by the Yoakum interests, it is reported, will be equipped for electrical operation. Work on an entension of 20 miles to the railroad starting from Shell Beach is now in progress. The older portion of the road is being reconstructed and standardized. The road when completed will be about 75 miles long.

SHREVEPORT, LA.—The Shreveport Gas, Electric Light & Power Company has awarded the General Electric Company a contract to install a new street-lighting system in Shreveport, which will call for an expenditure of about $20,000. The contract calls for luminous magnetite arc lamps, of which about 285 will be installed.

WATERVILLE, MAINE.—The Waterville & Oakland Street Railway Company has filed amendments to its charter changing its name to the Waterville, Fairfield & Oakland Street Railway Company and increasing its capital stock from $100,000 to $500,000. The Central Maine Power Company recently acquired control of the Waterville & Oakland Street Railway and the Waterville & Fairfield Electric Railway. Harvey D. Eaton, of Waterville, is president, and Walter S. Wyman, of Augusta, is treasurer of the Central Maine Power Company.

MIDDLETOWN, MD.—The town of Middletown has entered into a contract with the Frederick City Gas & Electric Company for furnishing electricity for lighting the city. Work will begin at once on the construction of the system. The company has rebuilt its transmission line from Frederick to Braddock Heights and will erect a new line from the Heights to Middletown.

BOSTON, MASS.—Mayor Fitzgerald has directed Superintendent of Supplies Mullen to readvertise for bids for the contract to supply the city with lamps and equipment for the method of partial municipal lighting. The Mayor takes the ground that as the apparently lowest bid received on the first call includes an estimate of the duty to be paid upon the lamp, rather than an actual statement of the cost to the city upon delivery in Boston, it would not be proper to accept this bid. The contract calls for furnishing 11,000 lamps.

CHICOPEE, MASS.—The Board of Electric Light Commissioners has engaged Engineer Whiting to prepare plans for the proposed improvements to be made to the municipal electric-light plant, for which bonds to the amount of $96,000 were recently voted. The plant when completed will have an output of 1550 kw. The equipment will include two 500-kw generators, one 350-kw and one 200-kw machine.

FITCHBURG, MASS.—The county officials are contemplating the installation of an electric-lighting system in the Worcester north county court house at Fitchburg, Mass.

FITCHBURG, MASS.—The Fitchburg Gas & Electric Light Company has petitioned the State Board of Gas and Electric Light Commissioners for permission to issue capital stock to the amount of $131,300.

HAVERHILL, MASS.—The Haverhill Electric Company has petitioned the Massachusetts State Board of Gas and Electric Light Commissioners for authority to issue 117 shares of additional capital stock, par value of $100, the proceeds to be used for payment of indebtedness incurrred in construction and improvements to its system.

HAVERHILL, MASS.—A movement has been inaugurated by the Haverhill Advertising Club for the installation of an ornamental street-lighting system in the business district. It is proposed to raise among the business men $12,600, the estimated cost to illuminate the retail business and manufacturing districts of the city for two years, after which it is proposed to turn the lamps over to the city. The plan is to utilize the present trolley poles, of which there are ninety in the district, each pole to be equipped with a bracket carrying four 60-watt tungsten lamps. The Haverhill Electric Company has offered to supply electricity to maintain the lamps at the rate of $70 per year for each pole.

MALDEN, MASS.—The Malden Electric Company has applied to the State Board of Gas and Electric Light Commissioners for authority to issue $207,000 in capital stock.

SUTTON, MASS.—The Worcester Suburban Electric Company is extending its commercial lighting and power circuits into the town of Sutton. The company will supply electricity to operate the municipal water-pumping station. The local telephone cables will be placed on the Worcester Company's poles, which will be 45 ft. in length.

TURNER'S FALLS, MASS.—A special town meeting has been called by the Selectmen of Gill to consider the question of lighting the streets of Riverside.

WEYMOUTH, MASS.—The stockholders of the Weymouth Light & Power Company have voted to appropriate $60,000 for extensions and improvements to its plant. The work will include the installation of a 1000-kw steam turbine with a Le Blanc condenser, a 400-hp boiler and a new chimney. Besides supplying electrical service in Weymouth the company furnishes energy to operate the municipal electric plant in Hingham and also electricity for lamps and motors in Hull.

STANDISH, MICH.—Negotiations have been closed whereby the local electric-light plant and water-works system have been purchased by C. F. Hall, proprietor of the City flouring and shingle mills. A new power house will be erected and the plant moved to the grist-mill property. Mr. Hall will apply to the City Council for a ten-year contract for lighting the city and for pumping water.

STANTON, MICH.—The Traverse City Iron Works have secured the contract for the construction of an electric-light plant and water-works system in Stanton.

COLERAINE, MINN.—Arrangements have been made by the Olive Iron Mining Company to light its plant in Coleraine by electricity. Cement will be supplied by the plant of the Western Mesaba Electric Company at Bovey, Minn.

JANESVILE, MINN.—The Village Council is reported to have granted the Consumers' Power Company a franchise to supply electricity for lamps in Janesville.

LAKE CRYSTAL, MINN.—The Consumers' Power Company has applied to the Council for a franchise in Lake Crystal. If granted, the company will extend its transmission line from the plant at the Rapidan dam, located near Mankato.

MADELIA, MINN.—The Consumers' Power Company of Mankato, Minn., is reported to have applied for an electric-light franchise in Madelia, Minn.

MINNEAPOLIS, MINN.—The Council water committee has instructed the city engineer to submit an estimate of the cost of installing an electric generating plant in the new filtration plant. Owing to the committee being unable to reach an agreement with the Minneapolis Gen-

eral Electric Company on the price for supplying electricity to operate the machinery in the plant, the committee has decided to make investigations as to the feasibility of installing a municipal plant to furnish the power. In case it is decided to build the plant, it is probable that all the machinery at the filtration plant, including the electrically driven centrifugal pumps, will be operated by power from the city plant. About 250 hp will be required to operate the machinery of the filtration plant.

TWO HARBORS, MINN.—Plans are being considered for installing a new electric unit in the municipal electric-light plant. Bids, it is said, will soon be asked on a 300-kw, 60-cycle, single-phase or two-phase generating unit. Bids will be considered for a direct-connected unit, also for belt, pulley drive, engine and generator, the engine to be a condensing engine without condenser.

VIRGINIA, MINN.—At a special election held Nov. 21 the citizens voted to instruct the city of Virginia to acquire by purchase or condemnation proceedings the water and light plant of the Virginia Electric & Water Company, to be owned and operated by the municipality. The City Council must secure a valuation of the property either by agreement under the terms of the franchise granted to the company or by applying to the district court for a board of appraisers to fix a fair valuation on the property.

WABASHA, MINN.—The Minnesota & Wisconsin Power Company is erecting a transmission line to Red Wing, and through Lake City to Wabasha. The company, it is said, expects to furnish electricity to the Wabasha "Big Joe" Roller Mill Company and other industries in this vicinity.

WADENA, MINN.—Plans for the installation of an ornamental lighting system from the Northern Pacific station to the court house are reported to be under consideration by the business men.

PRENTISS, MISS.—The local electric-light plant, owned by H. W. Hinton, has been purchased by W. C. Veach, foreman of the sawmill of the Taexler Lumber Company, of Prentiss. The machinery has been removed from the present power house to the Bozeman gin, where it has been installed.

JOPLIN, MO.—The city engineer, it is reported, has been instructed to prepare plans for the installation of an ornamental street-lighting system on Main Street from B Street to Twelfth Street and on Fourth Street from Kentucky Avenue to Jackson Avenue. Ornamental lamp standards will probably be used, each carrying a cluster of three lamps, with the exception of the corner standards, which will carry a cluster of five tungsten lamps. Arthur Cook is city engineer.

WINSTON, MONT.—Arrangements are being made by Henry M. Lancaster, of Spokane, Wash., owner of the East Pacific mine at Winston, to secure electricity from the transmission line of the Missouri River Power Company to light the mine and operate the machinery. It will be necessary to erect a transmission line 12 miles long to supply the service.

FAIRBURY, NEB.—The Council is reported to have rejected the turbo-generator set recently purchased for the municipal electric-light plant, considering it too small.

FALLON, NEB.—Plans and specifications have been approved by the City Council for the construction of a municipal electric-light system. The Council has authorized bonds to the amount of $15,000 to pay for same. Energy for operating the system will be secured from the government plant at Lahontan. The city will build the transmission line and distributing system.

KEARNEY, NEB.—The City Council has decided to submit to the voters the proposition to issue $40,000 in bonds, the proceeds to be used for the installation of a municipal electric-light plant in Kearney. The city is also considering the question of installing an ornamental street-lighting system. The cluster-lamp system is under consideration.

MARQUETTE, NEB.—The installation of a combined water and light plant in Marquette is reported to be under consideration.

WINSLOW, NEB.—An electric street-lighting system is being installed in Winslow. The power plant is to be located in the garage owned by William Brandert. The town officials have co-operated with Mr. Brandert to secure electricity to light the town. Tungsten lamps will be used for lighting the streets.

LAS VEGAS, NEV.—The Consolidated Power & Telephone Company is planning to increase the output of its plant, which supplies electrical service in this community. Orders have already been placed for a portion of the new machinery. Frank A. Clark is president of the company.

KEENE, N. H.—The Public Service Commission has authorized the Keene Gas & Electric Company to acquire $70,000 of the common stock and $70,000 of the preferred stock of the Ashuelot Gas & Electric Company, and has approved of the lease of the Ashuelot Gas & Electric Company to the Keene Gas & Electric Company. The Ashuelot Gas & Electric Company has been granted permission to supply electricity in the towns of Marlborough, Swansey and Winchester.

GARFIELD, N. J.—The Borough Council has abandoned the proposition to establish a municipal electric-light plant for the present. Reports submitted by engineers show that the cost of building a plant to meet the demands of the borough would be about $46,000. Several months ago bonds to the amount of $25,000 were voted to build a municipal plant.

NEWARK, N. J.—The contract for furnishing lighting fixtures for the Central High School has been awarded to R. C. Heather & Company, at $4,700, and that for supplying lighting fixtures for the Cleveland School to Jaehne & Company, for $1,880.

CUTTER, N. M.—The Vanadium Mines Company is reported to be considering plans for the installation of an electric power plant near Cutter. W. A. Bonitz, of Pittsburgh, Pa., is said to be interested in the project. The cost of the proposed plant is estimated at about $20,000.

DEMING, N. M.—The installation of a large hydroelectric power plant on the Gila River, 65 miles north of Deming, and the erection of electric transmission lines from the plant to Deming and through the Mimbres Valley to supply electricity for operating pumps, plants for irrigation purposes and other industries is being promoted by H. B. Johnson and R. H. Bouldare, of Silver City, N. M. The power site is located on the east fork of the Gila River. The first development will be a 15-ft. timber dam. The power diversion dam will be a 30-ft. dam where the flow of the river is 100 second-ft. without any storage. The cost of the entire project is estimated at $1,200,000, and it will require from two and one-half to three years to complete. The cost of the first development is estimated at from $300,000 to $350,000.

BINGHAMTON, N. Y.—Mayor J. J. Irving has signed the ordinance authorizing the city clerk to communicate with the New York State Conservation Commission for the purpose of having a representative sent to Binghamton to ascertain the amount of water-power to be obtained from the Susquehanna and Chenango Rivers with the possibility of utilizing it for a municipal lighting plant, a sewage plant and other proposed public utilities.

LE ROY, N. Y.—The Town Board has granted the Le Roy Hydraulic Electric & Gas Company a franchise to erect and maintain transmission lines for the distribution of electricity for lamps, heat and motors in Le Roy. It is understood that the company also proposes to supply electrical service in the towns of Stafford and Bergen.

NEW YORK, N. Y.—Bids will be received by Arthur J. O'Keefe, commissioner of bridges, Department of Bridges, 13 to 21 Park Row, New York, N. Y., until Dec. 14, for furnishing and erecting one duplex, two-stage, motor-driven air compressor at the Williamsburg Bridge, in the borough of Brooklyn. Blank forms and specifications may be obtained at the office of the Department of Bridges.

NEW YORK, N. Y.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Dec. 22 for wiring, etc., in the United States court house, New York, N. Y. James Knox Taylor is supervising architect.

ROCHESTER, N. Y.—The contract for rewiring the old building at the Rochester State Hospital has been awarded to the Rochester Electric Motor Company, of Rochester, at $6,350.

ASHEVILLE, N. C.—The Aluminum Company of America, of Pittsburgh, Pa., is reported to be interested in a water development on the Little Tennessee River Gap, west of Asheville, for which surveys are now being made.

ROCKINGHAM, N. C.—A deal has been closed whereby the Yadkin River Power Company has purchased the municipal electric-light plant in Rockingham for a consideration of $15,000. This secures for the company the Blewitt Falls plant, including water rights, dam, power house and transmission lines.

DAYTON, OHIO.—A company has been organized in Toledo for the purpose of harnessing the Big Miami River at Woodsdale, Ohio, between Hamilton and Middletown to develop power to operate a large electric plant. The company, which, it is said, includes Hamilton, Middleton and New York capitalists, contemplates the erection of a 28-ft. dam on the Miami River and a large electric generating plant, which will involve an expenditure of about $547,000. The Russell Company, of Dayton, Ohio, it is reported, will finance the project.

DELPHOS, OHIO.—The Delphos Home Telephone Company has increased its capital stock from $30,000 to $50,000.

GREENVILLE, OHIO.—The Greenville Electric Light & Power Company has been granted a franchise by the County Commissioners to erect and maintain electric transmission lines along certain roads in the country for a period of twenty-five years, with a view of supplying electricity in the villages of West Manchester and Lewisburg. The company has secured franchises to supply electrical service in these villages.

MARTIN'S FERRY, OHIO.—The Board of Control has awarded the contract for the new arc lamps for street lighting to the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa., at $1,325. The contract calls for a fifty-arc lamp system with the installation of twenty-five lamps. The new lamps will be erected in the central part of the city and the old lamps will be removed to new location in the outskirts.

SOUTH VIENNA, OHIO.—The Village Council has awarded contracts for machinery for the municipal electric-light plant as follows: To the Foos Gas Engine Company, of Springfield, Mass., for a 35-hp gas engine, oil to be used as fuel, and to the Western Electric Company for a 25-kw generator. The street-lighting system will consist of forty lamps. Charles C. Hubble, of the Hubble Engineering Company, of Columbus, Ohio, will have charge of construction of the plant.

TOLEDO, OHIO.—Mayor Whitlock and the executive heads of the city departments will consider plans for a high-pressure water-system pumping station, with a view of having it serve as a basic unit toward the establishment of a municipal electric-light and power plant to generate electricity for commercial purposes. Superintendent Goodwillie

has been instructed to prepare full data as to the requisites of a high-pressure plant. The Toledo Railway & Light Company has submitted a proposition offering to supply electrical power to operate a high-pressure system at $12,000 per year service charge and 2 cents per kw-hour additional for energy actually used.

OKLAHOMA CITY, OKLA.—The city clerk has been instructed to advertise for bids for the installation of an electrolytic sewage-disposal plant at Packington.

WOODWARD, OKLA.—Judge Cotteral of the United States court has rendered a decision in the case of the Woodward Cotton Company against the city of Woodward, involving the issuance of electric-light bonds by the city, which sustains the city's right to issue the bonds and to build an electric-light plant. The Woodward Cotton Company has a contract for lighting the city and attempted to restrain the city from building the municipal plant.

CORVALLIS, ORE.—Plans are being considered by the Portland, Eugene & Eastern Railway Company for the construction of an electric railway from Monroe to Corvallis. L. Welch is general manager.

PORTLAND, ORE.—Plans are being considered by the Port of Portland Commission for the installation of an electric-lighting plant on the tugboat Wallula.

PRINEVILLE, ORE.—Plans are being considered by Louis Gerlinger, Jr., manager of the Salem, Falls City & Western Railway Company, it is reported, for the construction of an electric railway from Metolius to Prineville.

PANAMA.—The contract for complete hydraulic power equipment for the hydroelectric plant at Gatun in connection with the Panama Canal has been awarded to the Pelton Water Wheel Company, of San Francisco, Cal. The equipment will consist of three 3600-hp, vertical-shaft Pelton-Francis turbines, operating under 75-ft. head at 250 r.p.m. for driving General Electric steam-turbine-type generators; three pipe lines, each 10 ft. 6 in. in diameter by approximately 300 ft. long; Pelton oil-pressure waterwheel governors and headgates.

CHESTER, PA.—The City Council has awarded the contract for street-lighting to the Beacon Light Company for a period of five years. Under the terms of the franchise the company is to supply arc lamps at $75 each per year; 16-cp incandescent lamps at $10.50 per lamp per year; 50-watt tungsten lamps at $19 each per year; 60-watt tungsten lamps at $21 per lamp per year; 80-watt tungsten lamps at $25 each per year, and 100-watt tungsten lamps at $29 each per year. The price for arc lamps is $5 less than under the present contract. There are 313 lamps now in use.

PHILADELPHIA, PA.—Sealed bids will be received until Dec. 11 by Henry Clay, director of public safety, Room 215, City Hall, Philadelphia, Pa., for furnishing electric arc lamps for the year 1912. Proposal blanks and specifications and all information may be secured at Room 610, City Hall, Philadelphia, Pa.

PITTSTON, PA.—A new electric-light company, to be known as the Garden City Electric Company, has applied to the Town Council of West Pittston for a franchise to install and operate an electric-light system in West Pittston. The Crosstown Street Railway Company has also applied for a franchise to construct and operate an electric railway in West Pittston.

ROYERSFORD, PA.—At an election held recently the proposition to appropriate $30,000 for the installation of a municipal electric-light plant was carried.

SPRING CITY, PA.—The contract for erecting a power house and laundry for the State Institution for Feeble-Minded and Epileptics, in Spring City, has been awarded to John R. Wiggins Company, of Philadelphia, Pa.

STATE COLLEGE, PA.—The Board of Trustees of Pennsylvania State College has authorized two new buildings. This provides for a new unit to the engineering building, 50 ft. x 100 ft., which will house the cement-testing laboratories, the high-tension electrical apparatus and the stock-rooms for the engineering departments.

SUNBURY, PA.—Negotiations have been closed whereby the Northumberland County Gas & Electric Company will take over the plant and holdings of the Middle Creek Electric Company. The property includes the water-power plant, located 2 miles south of Selinsgrove; all land purchased for dam purposes, the mill and water-power plant at Kratzerville, and the large steam plants in Sunbury and Northumberland. The consideration is said to be $223,500. The Northumberland company now owns all the gas and electric plants in Sunbury, Selinsgrove, Northumberland and Milton. It also has a lease on the Lewisburg plant for a term of ninety-nine years, and an option on the property of the Middleburg Light, Heat & Power Company.

ABERDEEN, S. D.—Frank F. Fowle, of Chicago, Ill., electrical engineer, engaged by the City Commissioners to investigate the local electric-light and power plant, owned by the Aberdeen Light & Power Company, has submitted his report. In the report Mr. Fowle strongly advises against granting a franchise to a second company, if the present company manifest a disposition to "make good," on the ground that there is not sufficient patronage for two competing companies in a city the size of Aberdeen. He suggests many improvements to the plant in order to enable the company to give satisfactory service, and suggests that three months is sufficient time to make the necessary inprovements.

MENNO, S. D.—The installation of an electric-light system in Menno is reported to be under consideration.

WAKONDA, S. D.—A company has been organized by local citizens under the name of the Wakonda Light, Power & Heating Company for the purpose of installing a plant in Wakonda.

COOKEVILLE, TENN.—The proposition to issue $30,000 in bonds for extensions and improvements to the electric-light plant and water-works system is reported to have been carried at an election held recently.

WAVERLY, TENN.—The city has decided to take over the local electric-light plant, owned by the Waverly Electric Light Company. It is proposed to replace the present arc-lamp street-lighting system with tungsten lamps. Bonds to the amount of $1,000 have been voted for improvements.

ABILENE, TEX.—The Abilene Independent Telephone & Telegraph Company is reported to be contemplating the erection of a new toll line to Northwest Texas. G. Klotz is general manager.

ARKANSAS PASS, TEX.—It is reported that bonds to the amount of $15,000 have been voted for the installation of an electric-light plant and water-works system.

CARLSBAD, TEX.—The contract for the installation of an electric-light plant, plumbing, heating and water-works at the tuberculosis colony at Carlsbad has been awarded to W. B. Kroeger, of San Antonio, Tex., for $14,650.

CLEBURNE, TEX.—Extensive improvements are contemplated by the Cleburne Telephone Company, which will involve an expenditure of about $50,000 and include the erection of 10 miles of cables throughout the city and new lines through the county and placing all wires underground in the city.

DALLAS, TEX.—Charles A. Mangold is promoting a project for the installation of an ornamental street-lighting system on Houston Street, from Commerce Street to Dall-Oak Cliff viaduct.

DALLAS, TEX.—John T. Witt has been granted a franchise to construct an interurban electric railway from the west bank of the Trinity River to a point in the county 10 miles west.

GRAPEVINE, TEX.—B. H. Yancy has purchased the property of the Grapevine Ice & Light Company. The new owner is making improvements to the plant and will install another generator and boiler.

THORNDALE, TEX.—The Thorndale Water Company has changed its name to the Thorndale Water & Light Company and increased its capital stock from $10,000 to $40,000. The company proposes to generate and sell electricity.

WICHITA FALLS, TEX.—The City Council has granted an extension to the contractors, Dobson & Gullahorn, until February, 1912, to complete the installation of new machinery in the local electric-light plant.

LEHI, UTAH.—The Utah Lake Irrigation Company is planning to install electric pumping machinery on its property near Saratoga Springs.

MURRAY, UTAH.—The City Council has decided to extend the street-lighting service into the southwestern part of the town. As soon as plans and specifications are completed fifty lamps will be erected. The Progress Company will supply electricity for maintaining the lamps at $1 each per month, making the total cost $600 per year.

FALLS CHURCH, VA.—The Town Council has passed an ordinance granting the Arlington Electric Company a franchise and has also voted to accept the proposal of the company to furnish electricity for street lighting. It is expected to have the system in operation by Jan. 1, 1912.

WINCHESTER, VA.—Arrangements are being made by the Winchester & Washington Railway Company for the installation of another large turbine in its plant; the present transformers are to be duplicated. The cost of the proposed improvements is estimated at about $1,000,000.

ASOTIN, WASH.—The Mount Vernon Telephone Company is planning to erect a telephone line to Asotin, Wash., and to the ranger headquarters near Dayton.

BELLINGHAM, WASH.—The City Council has instructed City Engineer Whitney to prepare plans and estimates for the installation of a municipal electric-light plant. The city engineer in a recent report to the Council stated that a plant of sufficient output to supply 125 arc lamps could be operated by power going to waste at the city pumping plant.

CASTLE ROCK, WASH.—Plans are being prepared by the Brown Company, Bailey Building, Seattle, Wash., for a light and power plant and the mechanical equipment for the Castle Rock Coal, Light & Power Company, to be located in Castle Rock. The cost of the work is estimated at $275,000.

CASTLE ROCK, WASH.—The Castle Rock Light & Power Company, recently incorporated, has taken over the property of the Huntington Coal Mining & Development Company and will make extensive improvements to the property. It is proposed to install an electric-power plant at once, to cost approximately $10,000. About $25,000 will be expended on the coal mine. The company is capitalized at $250,000, and the incorporators are: A. E. Braden, H. B. Davis, and I. W. Selden. The headquarters of the company will be located in Tacoma.

CLE ELUM, WASH.—The Kittitas Railway & Power Company has engaged the Brown Company, Bailey Building, Seattle, Wash., to make permanent surveys for the proposed new hydroelectric development and electric railway from this city into the Cle Elum flats, a distance of about 40 miles. The cost of the work is estimated at $1,500,000.

GOLDENDALE, WASH.—Plans are being considered by County Commissioner Barnes for the installation of an electric-light plant on his ranch, located on Little Klickitat Creek, near Goldendale.

PASCO, WASH.—The City Council has awarded a contract to the Evans-Dickson Company, of Tacoma, Wash., for furnishing and installing eighty-four ornamental lamp standards, each carrying a three-lamp cluster, for $5,980.

SEATTLE, WASH.—The Board of Public Works has granted the Seattle, Renton & Southern Railway Company permission to construct an electric railway on Fifth Street, between Main and King Streets, and also for the construction of a double-track line near Kenyon Street. The company is also making improvements to its railway between Rainer Beach and Taylor's Mill.

SEDRO-WOOLLEY, WASH.—The State Board of Control has awarded the contracts for construction of the proposed power plant at the Northern Hospital for the Insane at Sedro-Woolley to the Eckhart Heating & Plumbing Company, at $34,920; the contract for electrical work was awarded to the Standard Engineering Company, of Seattle, Wash., for $2,650. Saunders & Lawton, of Seattle, Wash., are the architects.

SPOKANE, WASH.—Preparations are being made to install a compressor and mill at the Amazon-Manhattan mine in the Sunset district near Wallace as soon as the transmission line of the Washington Power Company, which is to extend up Nine Mile Creek, is completed.

TACOMA, WASH.—The Great Northern Railway Company is planning to build a large dam in the gorge of the Chelan River, which connects Lake Chela with the Columbia River, where it is estimated that 100,000 hp can be developed. The proposed dam will be 200 or 300 ft. high, depending on the site used.

WENATCHEE, WASH.—The City Council is reported to be considering the installation of a fire-alarm system.

SISTERSVILLE, W. VA.—The Sistersville Electric Light & Power Company has awarded the contract for the construction of the addition to its power plant in Sistersville to John J. Rae, of Clarington. The new building will be 45 ft. by 75 ft. The new equipment will include two new engines of the Westinghouse type with a rating of 1000 hp each and a new switchboard. The company is planning to supply electricity to operate the new electric railway now being constructed from Sistersville to Middlebourne.

HILLSBORO, WIS.—The installation of an electric-light system in Hillsboro is reported to be under consideration.

LA CROSSE, WIS.—It is said that damages to the plant of the La Crosse Water Company cannot be completed until next spring. It is understood that efforts to cash receivership certificates to repair the damage have failed and a 5 per cent assessment has been made against the boldholders to raise the required amount. The damage to the plant at Hatfield is estimated at about $200,000. The company, it is said, may be reorganized during the winter. C. C. Smith is receiver.

NEENAH, WIS.—The Railroad Rate Commission has issued an order requiring the Wisconsin Traction, Heat & Light Company, which furnishes the local service, to comply with its order of Aug. 4 reducing the rates on electricity for lamps and gas in the city of Neenah 25 per cent.

RAYVILLE, WIS.—The town officials have engaged W. H. Wright, civil engineer, to prepare plans and estimates for the installation of an electric-light plant, water-works and sewer systems in Rayville.

SHEBOYGAN, WIS.—The K. Schreier Brewing Company is reported to be considering the installation of additional electrical generating machinery, including a 450-hp generating unit, consisting of Corliss engine and generator to supply energy for motors and a 30-hp generator to furnish electricity for lamps.

UNION GROVE, WIS.—The installation of an electric-light plant in Union Grove is reported to be under consideration.

CALGARY, ALTA, CAN.—The cost for the proposed extensions to the municipal lighting system is estimated at about $175,000. Most of the work will be in Crescent Heights and North Hill.

VICTORIA, B. C., CAN.—An electric-lighting plant will be installed on the new river steamer to be constructed by the British Columbia Express Company. Plans are being prepared by Alexander Watson, shipbuilder.

VICTORIA, B. C., CAN.—The City Council is contemplating extending the cluster street-lighting system.

BRANTFORD, ONT., CAN.—Plans are being considered by Mayor Armstrong of Paris and Mayor Rastall of Brantford regarding the submission of by-laws for securing electrical service from the Hydro-electric Power Commission in both municipalities. The agreement of the city of Brantford with the Cataract Power Company will expire within a year.

COBALT, ONT., CAN.—The Northern Ontario Light & Power Company, it is reported, has been organized to take over the properties of the Cobalt Power Company and its subsidiary companies and the Cobalt Hydraulic Power Company, Ltd. The companies furnish electricity for lamps, heat and motors in the towns of Cobalt, North Cobalt, Haileybury, Liskenard, Cochrane and Porcupine.

TORONTO, ONT., CAN.—The provincial government has granted the Ontario Hydroelectric Commission authority to lease Dams No. 4 and No. 8 on the Trent Canal. At Dam No. 4, which is on the Peterborough and Lakefield division, it is stated that about 3000 hp will be developed to supply electricity in Peterborough, Lakefield and immediate vicinity, while at Dam No. 8, which is on the Rice Lake branch, 5000 hp will be generated to supply electrical energy to the lower districts of eastern Ontario.

MONTREAL, QUE., CAN.—The Canadian Light & Power Company has acquired the controlling interest of the Saraguay Light & Power Company, of Montreal. The Canadian company has also taken over the property of the Central Light, Heat & Power Company, which has a steam plant in the commercial district.

MONTREAL, QUE., CAN.—The Cedar Rapids Manufacturing & Power Company has applied for permission to increase its capital stock from $250,000 to $10,000,000. Plans are being prepared by the company for the construction of a hydroelectric power plant at Cedar Rapids, 28 miles from Montreal. The initial installation will provide for 25,000 hp. The company expects ultimately to develop 150,000 hp, which it proposes to dispose of in bulk to existing companies for distribution. D. Lorne McGibbon is president and Henry Redgate consulting engineer.

CULIACAN, SINALOA, MEX.—The Guadalupe de Los Reyes Mining Company is planning to install an electric-power plant at its mines near Culiacan. The equipment will consist of two gas-producer engines with a rating of 180 hp each, a reserve gas generator and two electric generators with a rating of 120 kw. Salvador Ugarte, of Mexico City, has the contract for installing the plant.

MONTEREY, NUEVO LEON, MEX.—The Mexican Midland Light & Power Company, Ltd., of Montreal, Can., recently chartered with a capital stock of $45,000,000, is reported to have acquired the concessions and other holdings of the Mexican Hydroelectric Company, which had its headquarters in Mexico City. The company, it is said, will carry out the plans of the Mexican Hydroelectric Company for the installation of hydroelectric plants on the Waranjo River, in the state of San Luis Potosi, and the Rio Blanco, in the states of Nuevo Leon and Tamaulipas. Besides the available water-power owned by the company its concession from the federal government calls for the construction of electric railway systems and the erection of several hundred miles of transmission lines.

PACHUCA, HIDALGO, MEX.—The Fuerza & Ferrocarriles Company of Pachuca has applied for concessions for the construction of three hydroelectric power plants on the Tula River. The company proposes to develop 7900 hp with transmission lines to Tula, Jasso, Actopan and other mining towns in that district. Theodore Branderburg is general manager of the company.

Personal.

MR. ROBERT LINDSAY, general manager of the Cleveland Electric Illuminating Company, of Cleveland, Ohio, sailed from New York Dec. 2 for a month's vacation in southern waters.

MR. J. H. SHOEMAKER, of Waterloo, Ia., has resigned as general manager of the Corn Belt Telephone Company in order to enter a new field of work not identified with the telephone.

MR. F. J. WHITE, of the Okonite Company, will give a lecture on Thursday, Dec. 14, before the Electrical Engineers Society of Columbia University on the subject of the insulation of electric conductors.

MR. H. W. SMITH, formerly of the Milwaukee office of the Westinghouse Electric & Manufacturing Company, has been appointed electrical engineer of the Cleveland Construction Company, with headquarters for the present at Michigan City, Ind.

MR. GEORGE C. THORNTON and *MR. RICHARD W. ALGER* have formed a partnership for the practice of electrical and mechanical engineering under the firm name of Thornton & Alger, with offices in Chattanooga, Tenn. Particular attention will be given to the lighting of modern buildings and consultations for electrical power plants.

MR. R. M. JENNINGS, local manager for the Oregon Power Company at Marshfield, Ore., has been made manager of this company's properties at Eugene and Springfield, Ore., to succeed Mr. M. D. Spencer, who has been placed in charge of the gas and electric plants of H. M. Byllesby & Company at Monroe, Wash.

MR. WILLIAM COALE, of the Sterling Electrical Manufacturing Company, and chairman of the N. E. L. A. committee on light, heat and ventilation, was a guest of honor at the first meeting of the season of the Sidney (Ohio) Manufacturers' Association, at which he delivered an address on the subject of lighting by metallic-filament lamps.

MR. S. G. VIGO, formerly connected with the contract department of the Commonwealth Edison Company of Chicago, has accepted the position of power engineer for the Consumers' Electric Light & Power Company, of New Orleans. Before his departure Mr. Vigo was entertained at a farewell luncheon at the Grand Pacific Hotel by some of his Chicago friends.

MR. C. K. G. BILLINGS has resigned as a director and chairman of the board of directors of the People's Gas, Light & Coke Company, of Chicago. Mr. Anthony N. Brady, of New York, was chosen to

succeed Mr. Billings as chairman of the board, and Mr. James F. Meagher, of Chicago, was elected a director to fill the vacancy caused by Mr. Billings' resignation.

MR. W. F. RICHARDS, superintendent of lighting and power for the Toledo Railway & Light Company, has returned to the active direction of his department after an enforced vacation of several months necessitated by a general nervous breakdown early in the summer. Mr. Richards went at once to a resort in northern Canada, recuperating there sufficiently to return to Toledo in October, although not taking up active duties again until recently.

MR. FRANK R. COATES has been elected president of the Toledo Railways & Light Company, Toledo, Ohio. Mr. Coates, who is a graduate of Lehigh University, has been connected with many of the great railroads of the country since his graduation in 1890. From 1900 to 1904 he was chief engineer of the Chicago Great Western Railway, since which time he has been associated with the firm of Thomas Phee & Company, contractors, of Chicago.

MR. HERBERT LAWS WEBB has been made a director of the Constantinople Telephone Company, which takes over a concession negotiated by Mr. Webb for the establishment of a general telephone system—the first in Turkey—embracing Constantinople and adjacent territory. Among the other directors of the company are: Mr. F. R. Welles, vice-president of the French Weston Electric Company, and Mr. Ernest Thurnauer, general manager of the French Thomson-Houston Company.

MR. H. W. FULLER, who for a number of years was general manager of the Washington Railway & Electric Company, Washington, D. C., has severed his connection with that company, and, following the lead of his superior, General Harries, has associated himself with the Byllesby organization. Mr. Fuller has been appointed vice-president and general manager of the Appalachian Power Company, with headquarters at Bluefield, W. Va. This company, which is controlled by H. M. Byllesby & Company, is engaged in developing a number of water-power sites on the New River.

MR. SAMUEL G. McMEEN, of McMeen & Miller, electrical engineers, Chicago, has been elected president of the Mount Hood Railway & Power Company, of Portland, Oregon. This company has a hydroelectric development at Bull Run, with steam auxiliary station in Portland. It will distribute electrical energy in Portland and near-by territory. Mr. McMeen has spent some years on the Pacific Coast in connection with public utility enterprises which retained the services of his firm, and in particular was for some time vice-president in charge of the Bay Cities Home Telephone Company, of San Francisco. His work in Portland will not make it necessary for him to sever his connection with the firm of McMeen & Miller.

MR. ATLEE H. TRACY has joined the Columbus (Ohio) staff of E. W. Clark & Company, bankers, of Philadelphia, and is engaged in commercial engineering work on hydroelectric and railway properties under Mr. M. S. Hopkins, consulting manager and engineer. Mr. Tracy spent five years in London and Manchester with the British Westinghouse company during the electrification of the London Underground Railways, and was in the office of Mr. George Gibbs, chief engineer of electric traction, Pennsylvania Railroad, for the six years covering the design and installation of the West Jersey and Seashore Railroad and the Long Island and New York terminal electrification. He resigned last spring to accept, temporarily, an appointment as secretary to the department of Water Supply and Electricity, New York City, under Commissioner Thompson.

Obituary.

MR. GEORGE B. MOFFATT, a director of the Electric Bond & Share Company, New York, N. Y., and formerly president of the Oregon Electric Railway, which he was largely instrumental in organizing in 1906, died in Portland, Ore., on Dec. 4 at the age of fifty-seven years.

MR. JOHN F. McGLENSEY, illuminating engineer for the Union Electric Light & Power Company, of St. Louis, died on Nov. 11. Several years ago Mr. McGlensey was one of the estimating engineers in the contract department of the Commonwealth Edison Company of Chicago. He left that company to become manager for Henry Newgard & Company, electrical contractors in Chicago, and afterward joined forces with Kohler Brothers, of the same city. About a year ago he accepted the position in St. Louis which he held at the time of his death. Mr. McGlensey was a man of high character, and his death is greatly regretted by many friends.

PROF. ENGELBERT ARNOLD died from heart failure on Nov. 16 at Karlsruhe, Germany, after an illness of a week. Professor Arnold was born March 7, 1856, in Schlierbach, canton of Lucerne, Switzerland. He studied from 1874 to 1878 at the Institute of Technology at Zurich and then for several years was engaged in practical engineering work, one of his positions being with the Maschinenfabrik Heim at Offenbach. During the years 1880-1891 he was instructor at the Institute of Technology at Riga, Russia, and at the same time in charge of the engineering department of the Russian-Baltic Electrochemical Company. Later he was chief engineer of the Oerlikon Company in Switzerland. In 1894 he was called as professor to the Institute of Technology at Karlsruhe. This chair he occupied for almost two decades. In 1905 he was made a private councilor, and in 1906 received the honorary degree of doctor-engineer from the Institute of Technology of Hanover. During 1906-1907 he was rector of the Institute of Technology at Karlsruhe. Among his many contributions to technical literature are books on armature winding of direct-current machines (1890), working drawings of alternating-current dynamos (1899) and direct-current machines, besides five volumes on alternating-current engineering, all published in German.

MR. ALDEN M. YOUNG, well known in electric-lighting circles, died in New York on Dec. 3. He was born at Hadley, N. Y., Sept. 6, 1853, and after leaving school entered the telegraph business, filling positions successively at Saratoga, Albany, Syracuse, Buffalo and New York. In 1878 he organized the telephone exchange at Waterbury, Conn., and in 1890 he built Waterbury's first electric-light station. He then organized the Waterbury Traction Company and later merged it with the lighting company. About the same time he also founded the New England Engineering Company and contributed largely to the successful introduction of lighting and railway plants in several New England cities. His work as an organizer in Waterbury and in connection with the various other enterprises in which he was the guiding spirit attracted much attention both in financial and electrical circles. He later came to New York and helped to organize the Kings County Electric Light & Power Company, of Brooklyn. At the 1898 Chicago convention of the National Electric Light Association Mr. Young was elected president of that body, succeeding Mr. Samuel Insull. Early in life Mr. Young became associated with Mr. A. N. Brady and other financiers in many enterprises, and at the time of his death was associated with the following public-service corporations either as an executive officer or as a director: Albany & Hudson Railroad Company, American Gas & Electric Company, Connecticut Power Company, Connecticut Railway & Lighting Company, Corning Gas & Electric Company, Dayton Lighting Company, Edison Electric Illuminating Company of Brooklyn, Electric Bond & Share Company, Fairmont & Clarksburg Traction Company, Kings County Electric Light & Power Company, New London Gas & Electric Light Company, Northern Westchester Lighting Company, Norwich Gas & Electric Light Company, Rockville Gas & Electric Company and the Stamford Gas & Electric Company. He was also a director of the National Carbon Company and the Consolidated Engine Stop Company and president of the New England Engineering Company and other industrial enterprises. Mr. Young was in business with his son-in-law, Mr. M. J. Warner, under the firm name of Young & Warner, manufacturers of railroad supplies, at 30 Church Street, New York. The deceased is survived by a widow and four married daughters.

ALDEN M. YOUNG.

Trade Publications.

DIRECT-CURRENT MOTORS.—Bulletin No. 33 issued by the Peerless Electric Company, Warren, Ohio, describes in detail the features of design and construction as well as the adaptability of its direct-current motors for all classes and conditions of service. Bipolar types are built in sizes ranging from 1/30 hp to 1 hp, and multipolar types in ratings ranging from 1/4 hp to 35 hp.

ORNAMENTAL STREET LIGHTING.—The Sterling Electrical Manufacturing Company, Warren, Ohio, has issued an attractive treatise on tungsten street lighting, with construction and cost data, under the title "From Post-Hole to Lights On." The company manufactures only tungsten lamps, but for the convenience of the consumer has collected data pertaining to poles, ornamental metal standards, glassware, conduits, transformers, etc., which go to make up the complete equipment. The information is of immediate benefit to municipalities, business men's clubs, boards of trade and others contemplating the establishment of ornamental street-lighting systems.

BUSINESS NOTES.

HARVEY S. TONKS, secretary of the Ornamental Lighting Pole Company, announces the removal of the company's New York office from 90 West Street to 17 Battery Place.

PEERLESS ALTERNATING-CURRENT MOTORS.—The Peerless Electric Company, Warren, Ohio, announces a 1912 line of small alternating-current motors ranging in rating from 1/12 hp to ¾ hp.

FRANK B. COOK, of Chicago, manufacturer of telephone accessories, is about to remove his factory from that city to Zion City, Ill., where it will occupy one of the buildings formerly used by the colony of John Alexander Dowie.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED NOV. 28, 1911.

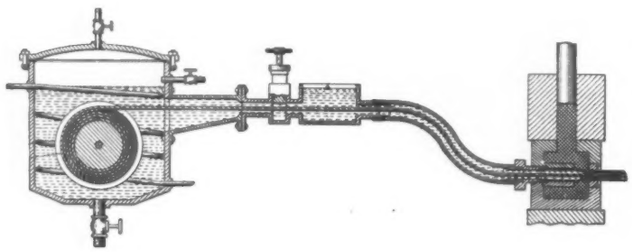
[Prepared by Robert Starr Allyn, 16 Exchange Place, New York.]

1,009,731. METHOD OF FORMING ELECTRIC CABLES AND APPARATUS THEREFOR; H. W. Fisher, Pittsburgh, Pa. App. filed Oct. 21, 1910. Applying the insulating compound.

1,009,732. MACHINE FOR COVERING ELECTRICAL CONDUCTORS; H. W. Fisher, Pittsburgh, Pa. App. filed March 20, 1911. Winding on the covering in the bath.

1,009,748. SWITCHING DEVICE FOR ELECTRICAL CIRCUITS; J. D. Hilliard and C. E. Parsons, Albany, N. Y. App. filed Aug. 22, 1906. Oil-break solenoid-operated switch.

1,009,762. TELEPHONE SYSTEM; R. H. Mason, Elyria, Ohio. App. filed May 29, 1907. "Measured service" system with meters controlled by the cord circuit.



1,009,731.—Method of Forming Electric Cables and Apparatus Therefor.

1,009,767. SHOE FOR THIRD-RAIL ELECTRIC CARS; L. A. McCoubrie and C. F. Raydure, Philadelphia, Pa. App. filed April 24, 1909. Removable contact piece. Improvement on Patent No. 985,430.

1,009,788. DYNAMO-ELECTRIC MACHINE; H. H. Ralston, Norwood, Ohio. App. filed Sept. 14, 1905. Slotted commutator section to receive the connectors.

1,009,798. PRODUCING MUSICAL TONES; M. L. Severy and G. B. Sinclair, Arlington Heights and Medford, Mass. App. filed Feb. 19, 1910. Electromagnetically operated strings.

1,009,810. INSULATOR; T. H. Watkins, Wakpala, S. D. App. filed June 21, 1911. A wire-holding plate is sprung in a socket.

1,009,813. TELEPHONE SYSTEM; H. G. Webster, Chicago, Ill. App. filed March 7, 1907. Party-line, common-battery, lock-out type.

1,009,831. ELECTRIC DISTRIBUTION; J. J. Creveling, New York, N. Y. App. filed Feb. 2, 1909. Compensating generator and storage-battery lighting regulation.

1,009,834. ELECTROTHERMAL SWITCH; J. Erickson, Chicago, Ill. App. filed May 9, 1906. A stationary terminal and a movable fusible disk for providing new contact positions.

1,009,939. MANUFACTURE OF VAPOR ELECTRIC APPARATUS; P. H. Thomas, East Orange, N. J. App. filed May 25, 1904. Auxiliary mercury-sealed chamber for facilitating formation of the vacuum.

1,009,940. VIBRATOR BOX; H. C. Thomson, Boston, Mass. App. filed Jan. 27, 1910. For internal combustion motor-ignition work.

1,009,951. ELECTRIC DYNAMO AND MOTOR; E. J. Armstrong, Erie, Pa. App. filed Dec. 18, 1909. Air cooled with dust filter.

1,009,969. IGNITER FOR GAS LAMPS; F. W. Hill, Chatham, Pa. App. filed March 16, 1910. For acetylene lamps on automobiles.

1,010,001. ELECTRODE COVER FOR ELECTRIC FURNACES; J. L. K. Snyder, Cleveland, Ohio. App. filed Sept. 5, 1911. The cover forms an adjustable electrode.

1,010,011. SECTIONAL INSULATOR; A. O. Austin, Barberton, Ohio. App. filed Dec. 15, 1909. Flanged insulator units and tubular spacers for high-tension cables.

1,010,025. ELECTRIC REGULATION; J. L. Creveling, New York, N. Y. App. filed July 27, 1910. Generator-storage-battery lighting system with carbon resistors automatically governed.

1,010,058. ALARM DEVICE FOR LUBRICATORS; F. Lemann, Posen, Germany. App. filed Dec. 29, 1910. A float in the oil cup to move contacts.

1,010,069. KNIFE SWITCH; H. L. Peat, St. Louis, Mo. App. filed July 3, 1911. Fuse may be above or below the blade.

1,010,077. STRAIN INSULATOR; W. Schaake, Pittsburgh, Pa. App. filed Jan. 26, 1910. Wood-bar construction adjustable in length.

1,010,083. TRANSFORMER; H. C. Soule, Wilkinsburg, Pa. App. filed Jan. 10, 1908. Circular coil-core type with adjustable means for securing the assembled windings to the core.

1,010,092. SMOOTHING IRON; T. G. Thomas, Houston, Tex. App. filed May 4, 1911. The body is of transparent glass with electric lamps inside.

1,010,096. OVERHEAD STRUCTURE FOR ELECTRIC RAILWAYS; T. Varney, Pittsburgh, Pa. App. filed Oct. 13, 1909. Auxiliary contact member for a gap in a trolley as on a drawbridge.

1,010,111. DRIVING MECHANISM; G. L. and F. E. Baker, Royal Oak, Mich. App. filed May 16, 1910. An electric motor mounted inside of a traction wheel.

1,010,118. COMMUTATOR BRUSH; J. L. Crouse, New York, N. Y. App. filed Feb. 6, 1906. The conductor plate has a resilient pin expanded into a hole in the carbon brush.

1,010,119. GAS-LIGHTING DEVICE; J. H. Crowner, Ottumwa, Ia. App. filed Dec. 8, 1910. Counterbalanced sparker.

1,010,125. CURRENT TAP; H. L. DeZeng, Philadelphia, Pa. App. filed May 24, 1910. A plug and two-part sleeve and lamp socket.

1,010,126. DYNAMO-ELECTRIC MACHINE; W. A. Dick, Pittsburgh, Pa. App. filed Dec. 31, 1908. Air-cooled field and coil construction.

1,010,134. COOLING DEVICE FOR ELECTRIC APPARATUS; C. Le G. Fortescue, Wilkinsburg, Pa. App. filed Nov. 6, 1908. Casing for transformer with means for circulating cooling fluid.

1,010,135. ALTERNATING-CURRENT MOTOR; V. A. Fynn, London, England. App. filed Feb. 24, 1910. Laminated rotor with squirrel-cage and commuted windings and a magnetic bridge.

1,010,165. INCANDESCENT LAMP; M. M. Merritt, Middleton, Mass. App. filed Feb. 24, 1906. Has an expansion member for fracturing the bulb when the lamp is "burned out," thus preventing renewal.

1,010,181. ELECTRIC-CABLE PROTECTOR; J. A. Sanford, Jr., East Liverpool, Ohio. App. filed July 7, 1911. A conducting shield on the head of an insulator to intercept a broken cross wire.

1,010,191. ELECTRIC HEATER; H. D. Shelton, Hughesville, Mo. App. filed Aug. 1, 1910. A disk-shaped heating unit to be mounted in a steam generator.

1,010,197. X-RAY TUBE AND VACUUM CONTROL THEREFOR; H. C. Snook and G. H. White, Philadelphia, Pa. App. filed April 7, 1911. Switching mechanism under control of the operator for varying the vacuum.

1,010,216. DYNAMO-ELECTRIC MACHINE; C. H. Bedell, Bayonne, N. J. App. filed Oct. 27, 1906. Sparkless commutator of multipolar machines.

1,010,251. AUTOMATIC FIRE ALARM; G. E. Glick, Carrington, N. D. App. filed July 8, 1909. Heat-expansible mercury container.

1,010,263. SYSTEM OF CONTROL FOR ELECTRIC MOTORS; H. D. James, Pittsburgh, Pa. App. filed Feb. 3, 1910. Regulating switches with relay switches and interlocking switches.

1,010,271. INDUCTION METER; R. C. Lanphier, Springfield, Ill. App. filed Nov. 9, 1910. Split-phase type; arrangement of the series and shunt field relative to the rotatable disk.

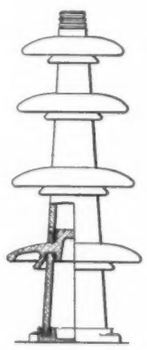
1,010,272. INDUCTION METER; R. C. Lanphier, Springfield, Ill. App. filed March 30, 1911. Removable shunt and series coils of split-phase, rotating-field type.

1,010,278. UNDERGROUND ELECTRICAL JUNCTION BOX; S. J. Lisberger and C. J. Wilson, San Francisco, Cal. App. filed Feb. 23, 1911. Three-phase, low-voltage, six-way junction box.

1,010,295. INCANDESCENT LAMP; M. M. Merritt, Middletown, Mass. App. filed Feb. 24, 1906. The bulb has a weakened area so that it will break in case an attempt is made to "renew" it.

1,010,371. ELECTRIC TRAIN-CONTROLLING DEVICE FOR RAILWAYS; R. T. and F. T. Jones, Baltimore, Md. App. filed Aug. 16, 1909. Block system using a ramp rail and air-brake operators.

1,010,372. TRAIN-CONTROLLING MECHANISM; R. T. and F. T. Jones, Baltimore, Md. App. filed May 23, 1910. Block system with cab signal and air brake.



1,010,011—Sectional Insulator.

1,010,377. STORAGE BATTERY; H. H. Kempf, New York, N. Y. App. filed May 13, 1910. Key-controlled meter attachment.

1,010,402. ELECTRODE FOR ARC LAMPS; J. J. H. Dempster, Schenectady, N. Y. App. filed Dec. 10, 1903. Purified natural titaniferous magnetite.

1,010,404. APPARATUS FOR PRODUCING NITROGEN COMPOUNDS FROM CARBIDES; A. R. Frank, Spandau, Germany. App. filed June 8, 1910. The carbide and the nitrogen are heated by an electric resistor.